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User's Guide to MOBILE4 (Mobile Source Emission Factor Model)

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This document is the User's Guide to MOBILE4. MOBILE4 is a computer program that calculates emission factors for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) from gasoline-fueled and diesel highway motor vehicles. The program uses the calculation procedures and emissionfactors presented in Compilation of Air Pollutant Emission Factors: Highway Mobile Sources (AP-42 Fourth Edition, September 1985). MOBILE4 calculates emission factors for eight individual vehicle types in two regions of the country. MOBILE4 emission estimates depend on various conditions such as ambient temperature, speed, and mileage accrual rates. MOBILE4 will estimate emission factors for any calendar year between 1960 and 2020, inclusive. The 20 most recent model years are considered to be in operation in each calendar year. MOBILE4 supercedes MOBILE3. Compared to MOBILE3, MOBILE4 incorporates several new options, calculating methodologies, emission factor estimates, emission control regulations, and internal program designs.

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to
MOBILE4
(MOBILE SOURCE EMISSION FACTOR MODEL)

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U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR AND RADIATION
OFFICE OF MOBILE SOURCES
EMISSION CONTROL TECHNOLOGY DIVISION
TEST AND EVALUATION BRANCH
2565 PLYMOUTH ROAD
ANN ARBOR, MICHIGAN 48105

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ABSTRACT

This document is the USER'S GUIDE to MOBILE4. MOBILE4 is a computer program that calculates emission factors for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) from gasoline-fueled and diesel highway motor vehicles. The program uses the calculation procedures and emission factors presented in Compilation of Air Pollutant Emission Factors: Highway Mobile Sources (AP-42 Fourth Edition, September 1985). MOBILE4 calculates emission factors for eight individual vehicle types in two regions of the country. MOBILE4 emission estimates depend on various conditions such as ambient temperature, speed, and mileage accrual rates. MOBILE4 will estimate emission factors for any calendar year between 1960 and 2020, inclusive. The 20 most recent model years are considered to be in operation in each calendar year. MOBILE4 supercedes MOBILE3. Compared to MOBILE3, MOBILE4 incorporates several new options, calculating methodologies, emission factor estimates, emission control regulations, and internal program designs.

A revised supplement to the AP-42 document referenced above will be prepared using MOBILE4 later in 1989. When this updated supplement becomes available, it will be distributed to EPA Regional Offices and will be available through the National Technical Information Service. Section 2.5 of this User's Guide contains information on ordering documents from NTIS.

Requests for copies of the MOBILE4 program and for additional copies of this User's Guide should be directed to the following:

The National Technical Information Service (NTIS)
U. S. Department of Commerce
Springfield, Virginia 22161

Telephone: (703) 557-4650

Questions concerning MOBILE4 or this User's Guide should be directed to the following:

U. S. EPA Motor Vehicle Emission Laboratory
Office of Mobile Sources
Emission Control Technology Division
Test and Evaluation Branch
2565 Plymouth Road
Ann Arbor, MI 48105
Attn: MOBILE4

Telephone: (313) 668-4462 (FTS 374-8462)

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Chapter 1

GENERAL DESCRIPTION OF MOBILE4

1.0 INTRODUCTION

MOBILE4 is an integrated set of FORTRAN routines for use in the analysis of the air pollution impact of gasoline-fueled and diesel highway mobile sources. The system has been designed to provide the user with a flexible analytical tool which can be applied in a wide variety of air quality planning functions. MOBILE4 is an update of its predecessors MOBILE 1, 2, and 3.

MOBILE4 calculates emission factors for gasoline-fueled light-duty vehicles (LDVs), light-duty trucks (LDTs), heavy-duty vehicles (HDVs), and motorcycles, and for diesel LDVs, LDTs, and HDVs. EPA's emission factor data base does not contain adequate data to model emission factors for vehicles using alternative fuels or fuel blends (such as oxygenated fuels) in the same way that gas and diesel emission factors are modeled. Modeling emission factors for vehicles operated on oxygenated fuels depends on a number of other variables, such as the oxygen content of the fuel, that MOBILE4 is not coded to handle. EPA has developed procedures for modeling emission factors for vehicles operating on oxygenated and alternative fuels, which are detailed in the report "Guidance on Estimating Motor Vehicle Emission Reductions From the Use of Alternative Fuels and Fuel Blends." See section 2.5 for information on obtaining this report.

This chapter explains the primary technical differences between MOBILE4 and MOBILE3. Instructions on how to use the program are contained in Chapter 2 (MOBILE4 Inputs), Chapter 3 (MOBILE4 Outputs), Chapter 4 (MOBILE4 Implementation), and Chapter 5 (MOBILE4 Examples). The source code listing of the MOBILE4 program has been printed under separate cover, rather than being included as an appendix to the User's Guide as was done with earlier versions of the model. Of course, the user possessing a copy of MOBILE4 on magnetic tape can generate their own listing of the source code.

This User's Guide is intended to be a self-contained document, such that earlier versions of the User's Guide are no longer necessary references for operation of MOBILE4. Although not required for the use of MOBILE4, some users may still wish to obtain the User's Guide to MOBILE2 and User's Guide to MOBILE3. Information on obtaining these documents appears in section 2.5.

1.1 PRIMARY TECHNICAL DIFFERENCES FROM MOBILE3

In addition to updates that have been made to the emission factor data base as a result of the considerable amount of new test data collected since the development of MOBILE3, there have been a number of changes to the methodology used to calculate some of the emission factors and correction factors. This section does not attempt to detail every case where the data base has been updated. The sections below describe (1) those features that are entirely new to MOBILE4, and thus have no direct corollary in earlier versions of the model, and (2) those features that have been significantly revised since MOBILE3. The "new" features are described in sections 1.1.1 thorough 1.1.4, and the significantly revised features are described in sections 1.1.5 through 1.1.13.

1.1.1 Addition of Running Loss Emissions

Perhaps the most significant change to MOBILE4, at least in terms of the output emission factors, is the addition of running loss hydrocarbon (HC) emission factors. Running loss emissions are defined as evaporative emissions occuring while the vehicle is in operation, that is, while it is being driven. The occurrence of running loss emissions appears to be at least in part the result of insufficient evaporative canister purging during vehicle operation; when the canister reaches saturation and evaporative emissions continue to be generated as a result of fuel tank temperature increases, these emissions are released from the vehicle into the atmosphere. Vehicle fuel system leaks, and possibly other sources, may also contribute to the generation of running loss emissions. These emissions were assumed to be zero in all previous versions of the mobile source emission factor model.

Test programs conducted by EPA beginning in 1988 have shown that running loss emissions are not zero under many conditions, particularly at the lower speeds representative of urban driving. Running losses have been determined to be a function of several variables, most importantly temperature, fuel volatility, and average speed of operation. These emissions also depend on vehicle type, vehicle age, and the evaporative control system.

Since there are as yet insufficient data to characterize running loss emissions in the level of detail used for the modeling of exhaust and "standard" evaporative emissions (i.e., hot soak and diurnal evaporative emissions), a number of assumptions have been incorporated into MOBILE4 to allow the calculation of running loss emission factors. These emissions will be calculated whenever HC emission factors are requested, and are included in the total HC emission factors. If listing of the individual components of the HC emission factor are requested, these emissions are listed separately under the heading "Runing L" (see section 3.3), along with the exhaust, "standard" evaporative, and refueling loss (see sections 1.1.2 and 2.2.7) HC emissions.

EPA's data have shown that running loss emissions are a non-linear function of temperature, fuel volatility (as measured by RVP), and average speed. Running loss emissions are higher at higher temperatures and higher volatilities (as are other evaporative emissions), and are higher at lower average speeds (reflecting the lesser canister purging that occurs at low speeds). The data on which the running loss emission factors used in MOBILE4 are based on tests of light-duty gasoline-fueled vehicles and trucks tested over three different driving cycles having different average speeds, at several different temperatures, and using fuels of varying volatility.

Results from running loss testing over these three driving cycles, which included the FTP, showed that running loss emissions were very low at highway speeds, regardless of temperature or fuel volatility. This reflects the fact that at higher speeds, the purging of the evaporative control canister generally is more than adequate to handle evaporative emissions generated while driving. Running loss emissions are higher at FTP speeds, which are considered representative of much urban driving. The highest running losses as a function of speed occurred over the lowest speed cycle used, corresponding to the conditions in which the least degree of canister purging occurs.

As with other evaporative emissions, running losses increase rapidly with increasing fuel volatility and temperature. In MOBILE4, ceilings are placed on the increase in running losses with increasing temperature and volatility to avoid unreasonable extrapolation based on limited data. Maximum running losses are assumed to occur at 105°F (41°C), with temperatures over that resulting in no further increase in running losses. Maximum running losses as a function of fuel volatility are assumed to occur at 11.7 psi RVP, which is the highest volatility fuel for which EPA has collected data.

In MOBILE4, running losses are calculated as a function of temperature and fuel volatility. The available data were insufficient for the direct modeling of running losses as a function of vehicle speed in MOBILE4, thus the running loss emission factors are a weighted composite of the results determined for the three average speeds tested, with appropriate weighting for fractions of vehicle travel in each of three bands of average speed. These weighting factors were determined on the basis of urban travel characteristics, and are not appropriate for application to rural areas. Separate running loss emission factors are calculated for each gasoline-fueled vehicle type except motorcycles (which represent a very small fraction of VMT).

As EPA continues to develop more running loss test data, the modeling of running loss emissions may be made more specifically speed-dependent in the future. However, the estimated emission factors in MOBILE4 are considered reasonably accurate for urban areas, and are certainly much more closely representative of actual in-use running loss emissions than were the previous assumptions (i.e., that there were no running loss emissions).

1.1.2 Addition of Refueling Emissions

Another type of evaporative HC emissions that were not included in previous versions of the model are refueling emissions. These emissions, also termed "Stage II" emissions, are generated when vehicles are refueled. (Stage I emissions are HC vapor emissions displaced to the atmosphere from underground service station gasoline storage tanks when these tanks are refilled, and are already controlled in most areas.) Stage II refueling emissions consist primarily of displacement losses, which occur during vehicle refueling when the gasoline vapor filling the vehicle fuel tank vapor space (that space remaining above whatever liquid fuel remains in the tank) are displaced by incoming fuel and released to the atmosphere, and to a lesser extent of spillage losses (whatever fuel is spilled, or dripped from the dispensing nozzle, during vehicle refueling, which completely evaporates). EPA estimates that vehicle refueling emissions account for approximately two percent of the overall inventory of HC emissions in urban areas.

In previous versions of the mobile source emission factor model, refueling emissions were not accounted for. Stationary source emission inventory "Stage II" emissions, based on total gasoline throughput and an associated emission factor, were previously the only method available for modeling these emissions. MOBILE4 has incorporated refueling emission data combined with fleet fuel economy data to yield refueling emission factors in grams per mile for LDGVs, LDGTs, and HDGVs. By modeling refueling emissions as a mobile source, the relative contribution of these emissions to overall mobile source HC emissions is made clearer, and the air quality planner can model the impact of onboard or Stage II vapor recovery system requirements on these emissions. See section 2.2.7 for additional information.

Vehicle refueling emissions are calculated and included in the total HC emission factors, unless MOBILE4 is specifically instructed not to do so through the use of the RLFLAG control flag (see section 2.1.12). If the user requests that the components of the total HC emission factor be listed in the output, these emissions are identified by the label "Refuel L" (see section 3.3), and are listed along with exhaust, evaporative, and running loss HC emissions.

1.1.3 Volatility Emissions Impact and Volatility Control

EPA's certification procedures for new motor vehicles, and much of the emission factor data base used for MOBILE4, are based on testing using gasoline with volatility of 9.0 psi Reid vapor pressure (RVP). This was representative of the gasoline marketed in much of the country in the early to mid 1970s, when these test procedures were developed. In recent years, the volatility of commercially marketed fuel has increased substantially. Emission factor program testing has demonstrated that increased fuel volatility has an impact on all components of vehicle HC emissions. This impact is greatest on evaporative emissions, including running loss emissions, but also is seen in the exhaust emission results.

MOBILE1 and MOBILE2 assumed 9.0 psi RVP fuel in calculating emission factors. MOBILE3 accounted for the increase in commercial fuel volatility that was already being seen in the early 1980s by basing evaporative emission factor results on commercial (11.5 psi RVP) fuel. (Exhaust emission factors were still based on 9.0 psi RVP fuel.) MOBILE4 takes this several steps further by modeling the impact of fuel volatility on exhaust HC, CO, and NOx emissions, and on hot soak and diurnal evaporative, refueling, and running loss HC emissions. In addition, the user of MOBILE4 can model the effects of different volatility in a future evaluation year, as would be seen if a program to regulate in-use fuel volatility (whether on the Federal, regional, or State level) were implemented. Only a single change in fuel volatility can be modeled within a single MOBILE4 run.

The effects of fuel volatility on exhaust emissions are modeled dependent on temperature, with the impact of increased volatility being greater at higher temperatures. For model year (MY) 1970 and earlier LDGVs, no impact of volatility on exhaust emissions is modeled. For MY 1971-79 HC and CO emissions from LDGVs, the volatility impact on exhaust emissions is applied as a correction factor calculated independent of the temperature correction factor, but with the volatility correction factor being a function of temperature. No volatility impact on MY 1971-79 NOx emissions was statistically significant on the basis of available data, thus none is included in MOBILE4. For MY 1980 and later LDGVs, for all three pollutants, the volatility correction is calculated in conjunction with the temperature correction factor for temperatures at and above the standard FTP temperature of 75°F (see section 1.1.9). The volatility corrections for LDGT and HDGV exhaust emissions are based on the LDGV data and model year mappings that take into account the evaporative emission control technology in use.

The effects of temperature and fuel volatility on "standard" evaporative emissions (hot soak and diurnal) are also modeled. See section 1.1.11 for discussion of the changes made in the calculation of evaporative emission factors. The effects of volatility on refueling emissions are based on the ASTM volatility class of the area being modeled, which approximates the actual in-use RVP for a given area. Running loss emissions are a direct function of the user-specified RVP for the evaluation year.

The effects of fuel volatility on emissions, as noted above, appear to vary with temperature, with larger emissions impacts observed at higher temperatures. In MOBILE4, volatility has no effect on exhaust emissions if the temperature used for correcting exhaust emissions is at or below 40°F. Evaporative emissions (hot soak, diurnal, running loss, and refueling) are not calculated at all if the applicable temperatures are at or below 40°F (see section 1.1.11). For temperatures above 40°F, fuel volatility impacts all components of HC emissions, with the effects increasing with increasing temperature.

The MOBILE4 user must now specify a base year RVP level in the input. This value should be representative of the RVP of gasoline marketed in the area being modeled in the base year of the analysis (in most cases, this will the same as current in-use average fuel RVP). The impacts of a fuel volatility control regulation, such as that proposed by EPA in August 1987, can also be modeled through the specification of the in-use fuel volatility controlled level and the year in which the in-use control program takes effect. The effects of volatility apply to all vehicles, regardless of age, and thus do not depend on fleet turnover to show an impact on the emission factors. Specification of an in-use fuel volatility control program results in a one-time "step" change in the emission factors, with all evaluation years up to the last year before the in-use start year modeled using the base RVP value, and all evaluation years beginning with the in-use start year modeled using the in-use (controlled) RVP level. See sections 2.2.12 and 2.2.13 for additional discussion.

1.1.4 Temperature Calculations

In MOBILE3, the user specified an ambient temperature as part of the required Scenario descriptive (or parameter) record. This temperature was used in the calculation of temperature correction factors (TCFs) for exhaust HC, CO, and NOx emissions. The evaporative emission factors calculated by MOBILE3 were based on standard FTP evaporative emission rates (including diurnal temperature range of 60°-84°F and hot soak temperature of 82°F), regardless of the input ambient temperature.

MOBILE4 uses a considerably more sophisticated approach to correcting emission factors for temperature, with the result being both more accuracy in the temperature corrections and more consistency in the temperature corrections applied to various components of overall emissions. This is accomplished by requiring the user to input three temperature values: minimum daily temperature, maximum daily temperature, and ambient temperature. There is a new flag in the Control section of the input (TEMFLG, see section 2.1.14), which partly determines how these three temperatures will be used in the correction of emission factors for temperature effects.

If the value of TEMFLG is 1 (as is recommended for most SIP-related modeling), then MOBILE4 uses the input minimum and maximum daily temperatures to calculate up to nine other temperatures for use in correcting various components of emissions (see section 1.1.11). Although the user must still supply a value of ambient temperature as part of the Scenario section data, this value is not used if TEMFLG = 1. MOBILE4 allows the user-input ambient temperature to be used in emission factor temperature corrections, by setting TEMFLG = 2, although the use of this option is recommended only in certain specific modeling situations (see section 2.2.11.3).

There are up to six emission factors that are corrected for temperature in MOBILE4 (exhaust HC, exhaust CO, exhaust NOx, diurnal evaporative HC, hot soak evaporative HC, and running loss HC), depending on the temperature(s) applicable to the scenario being evaluated. If TEMFLG = 1, the temperatures used in determining the corrections for the three exhaust emission factors, and for the hot soak and running loss HC emission factors, are determined by MOBILE4 on the basis of the input minimum and maximum daily temperatures and the variation in emissions with temperature over that temperature range. See section 2.2.11.3 for additional discussion.

The diurnal portion of evaporative HC emissions is calculated on the basis of the temperature rise (maximum minus minimum) vehicles would experience on a day with the given minimum and maximum temperatures. See section 1.1.11 for additional description of the changes in the calculation of hot soak and diurnal evaporative emission factors in MOBILE4.

The use of the input minimum and maximum daily temperatures, and the calculation of the appropriate temperatures for use in correcting emission factors on the basis of those temperatures, leads to temperature correction factors (TCFs) that more accurately reflect average emissions over the course of a given day characterized by the minimum and maximum temperatures specified. In addition, the evaporative emissions are now corrected for temperature, and thus are more consistent with the exhaust emissions calculated for the same scenario.

If TEMFLG = 2, then the input ambient temperature is used as the temperature for calculation of the exhaust TCFs for all three pollutants, the hot soak TCF, and running loss emissions. However, the input minimum and maximum temperatures are still used in the calculation of the diurnal emission factors. For this reason, all three temperatures must be specified in the input regardless of the value assigned to TEMFLG, and care should be taken in making the relationship between the three input temperature values realistic (e.g., the ambient must lie between the minimum and the maximum, the maximum must be greater than or equal to the minimum).

Additional information related to the use of temperature input data in MOBILE4 and its use in correcting emissions for the effects of temperature can be found in sections 2.1.14 (TEMFLG), 2.2.11 (Minimum and maximum daily temperatures), and 2.3.4 (Ambient temperature). Suggested guidance on the determination of appropriate temperatures for use in SIP-related modeling for both ozone (HC emissions) and CO appears in Appendix 2C to Chapter 2 of this document.

1.1.5 Deterioration Rates for MY 1981+ LDGV Emissions

As in all previous updates of the emission factor model, the basic emission rates have been revised to reflect additional emission factor test program data. In MOBILE4, the additional data collected and analyzed since the previous revision of the model has resulted in a more significant change in the modeling of 1981 and later model year light-duty gasoline-fueled vehicle emissions. For exhaust HC and CO emissions only, there are now two separate deterioration rates applied to the emission factors.

All basic emission rates are modeled using a zero-mile level (ZML), which is an expression of new vehicle emissions in g/mi. Since vehicle emissions have been modeled as a linear function of vehicle age (for properly maintained, non-tampered vehicles), the ZML can also be interpreted as the y-intercept of a line defining emissions as a function of accumulated mileage. The slope of this line is termed the deterioration rate (DR), and expresses the increase in emissions per 10,000 miles of accumulated mileage. Thus, the units of the DR are (g/mi)/10K mi.

Emission factor data for 1981 and later LDGVs show that emissions from these vehicles deteriorate at a more rapid rate (i.e., the line defining emissions as a function of accumulated mileage has a steeper slope) after 50,000 accumulated miles than before 50,000 miles. For this reason, MOBILE4 uses two deterioration rates in the modeling of 1981+ LDGV exhaust emissions: one applicable to accumulated mileage up to 50,000 miles, and a second, higher one applicable to accumulated mileage after 50,000 miles. While there is some reason to believe that similar behavior would be exhibited for late model light-duty gasoline-fueled trucks (LDGT1s and LDGT2s), based on the similarities in the stringency of applicable emission standards and emission control technology used, the emission factor data base does not yet reflect similar emissions deterioration behavior for these vehicles with sufficient confidence for incorporation of this effect in MOBILE4. Thus, the use of two deterioration rates in MOBILE4 is limited to 1981 and later LDGVs.

The impact of this change on the user of MOBILE4 is transparent, except when alternate basic emission rates are being input to the model. If the user is implementing modifications to the basic exhaust emission rates for 1981+ LDGVs (thorugh use of the NEWFLG control flag; see section 2.1.8), then two deterioration rates must be supplied. See section 2.2.4 for further information.

1.1.6 Basic Emission Rates for HDVs

EPA regulates heavy-duty gasoline-fueled and diesel engines (HDGEs and HDDEs) on the basis of mass emissions per unit work performed, rather than per unit distance travelled, due to the wide variety of in-use applications of such engines. The units are grams per brake horsepower-hour (g/BHP-hr). MOBILE3 modeled heavy-duty vehicle (HDV) emission factors using emission rates expressed in grams per mile (g/mi), with the conversion of g/BHP-hr to g/mi emission rates based on conversion factors expressing the average amount of work performed by different engines in order to travel given distances. In MOBILE4, updated model-year-specific conversion factors are used to convert modified basic emission rates in g/BHP-hr to g/mi rates internally. This provides for compatibility of HDV emission factors with those for other vehicle classes and for use in inventory development.

In a similar fashion to the change described above for 1981 and later LDGV emissions, this change is transparent to the MOBILE4 user, unless the user is supplying modifications to the basic emission rate equations applicable to HDVs. Rather than g/mi rates, the user must supply modifications to the HDV emission rates in terms of g/BHP-hr for the ZML and (g/BHP-hr)/10K mi for the DR. See section 2.2.4 for additional information.

1.1.7 Component HC Emission Factors

With the addition of running loss (section 1.1.1) and refueling loss (section 1.1.2) HC emissions to MOBILE4, the HC total and component emission factors are now different than were seen in MOBILE3. The total HC emission factor includes running losses, and also includes refueling losses unless they are specifically excluded by the user through the RLFLAG control flag (see section 2.1.12). When the user requests that the the component emission factors constituting the total HC emission factor be printed in the output (through the use of the HCFLAG control flag; see section 2.1.19), there will now be four components, rather than the two shown by MOBILE3. These components are exhaust emissions (same as MOBILE3), evaporative (hot soak and diurnal) emissions including crankcase emissions (same as MOBILE3), refueling emissions (unless excluded through use of RLFLAG), and running loss emissions. This also results in considerably longer MOBILE4 formatted output reports, as described in section 3.3.

1.1.8 Idle Emission Rates

The idle emission rates in MOBILE4 have been updated for the first time since the release of MOBILE2 in 1981. There are four differences in the idle emission factors for MOBILE4.

For HC and CO emissions, the idle emission rates are now estimated as a function of stabilized FTP emission rates for the following vehicle types and model year groups: 1977 and later LDGVs, 1979 and later LDGTs, and 1984 and later HDGVs. For properly functioning vehicles, stabilized (hot) idle emission rates are logically only slightly lower than very low speed emissions in stabilized operating mode, since the demand placed on the vehicle engine differs only slightly between idle operation and very low speed operation.

This statement is literally true only if the comparison between idle and low speed emissions is made in consistent units, namely in grams pollutant per unit time. In MOBILE4, idle emissions are calculated and expressed in the output in units of grams per hour (g/hr). This is the second difference, in that idle emissions in MOBILE3 were expressed in g/min. Thus, the numerical values of the idle emission factors will look very large relative to those of MOBILE3. When converted to the same units, the differences between MOBILE3 and MOBILE4 idle emission factors generally are not large.

The other two differences relate to the inclusion in the idle emission factors of the benefits of I/M programs and of offsets for certain forms of tampering. The forms of tampering which are considered to affect idle emissions are misfueling, catalyst removal, and air system (air pump or pulse air) disconnection. The idle I/M credits are the same in percentage terms as the corresponding FTP cycle I/M credits.

1.1.9 Exhaust Emission Temperature Corrections

The coefficients of the temperature correction factor equations for exhaust HC, CO, and NOx emissions have been updated on the basis of additional test data obtained since development of MOBILE3. For "high" temperatures (greater than the standard FTP temperature of 75°F), as noted in section 1.1.3, the temperature correction factor model now accounts for the effects of temperature, fuel volatility, and interactions between the two effects. This combined RVP and temperature correction factor model is applied only for 1980 and later model year LDGVs and 1981 and later model year LDGTs, since these are the only vehicles for which adequate test data with both varying temperature and fuel volatility are available.

1.1.10 Trips per Day and Miles per Day

MOBILE3 assumed that all LDGVs and LDGTs travelled 31.1 miles per day (MPD) took 3.05 trips per day (TPD). The corresponding values for HDGVs and motorcycles were 36.7 MPD/6.88 TPD and 8.30 MPD/1.35 TPD, respectively. These values were constant for vehicles of all ages, based on average travel characteristics.

In MOBILE4, the values of TPD and MPD have been updated on the basis of more recent information, and have been made a function of vehicle age for LDGVs and LDGTs (for HDGVs and motorcycles, due to insufficient data, constant TPD and updated MPD values continue to be used in MOBILE4). Thus, MPD is tied directly to the annual mileage accumulation rate by age for LDGVs and LDGTs (see section 2.2.3). TPD is a function of vehicle age only. This clearly reflects the data more accurately, since all available data indicate that newer vehicles are driven more often (higher TPD) and for greater distances (higher MPD) than are older vehicles.

Considering the analysis used to develop the functions expressing TPD and MPD as functions of vehicle age, and the importance of these values in the determination of evaporative emission rates in g/mi terms (see section 1.1.11), this change led to another change in MOBILE4 relative to MOBILE3. The old ICEVFG flag has been deleted, and is replaced by the HCFLAG flag (section 2.1.19). As part of this change, the MOBILE4 user is no longer permitted to input TPD and MPD rates different from those included in MOBILE4. (However, as noted above, MPD is a function of the annual mileage accumulation rates by age. Since it is possible for this information to be altered by the user having adequate locality-specific data, the user indirectly is still capable of incorporating locality-specific information in the MPD calculations.)

1.1.11 Revisions to Evaporative Emission Factor Calculations

Numerous significant revisions have been made to the calculation of hot soak and diurnal evaporative HC emissions in MOBILE4. These are briefly described below.

In MOBILE3, evaporative emission rates by vehicle type, model year group, and fuel delivery system did not vary on the basis of temperature information input by the user, or on the basis of fuel volatility. Thus, evaporative emission factors always reflected the conditions of the FTP, with the diurnal emission rates based on temperatures ranging from 60° to 84°F, the hot soak emission rates based on 82°F, and both based on commercial (11.5 psi RVP) fuel, regardless of the temperature specified by the user.

In the conversion of evaporative emission rates to g/mi units, MOBILE3 used a constant average of 3.05 trips per day (TPD) and 31.1 miles per day (MPD) for all LDGVs and LDGTs, with each vehicle assumed to undergo one hot soak after every trip and one complete diurnal per day:

$$\text{Evap HC (g/mi)} = \frac{3.05 * [\text{Hot soak emissions (g/test)}] + [\text{Diurnal emissions (g/test)}]}{31.1 \text{ miles}}$$

In MOBILE4, there are three major differences in the calculation of evaporative emission rates. Both diurnal and hot soak rates are now based on the user input minimum and maximum daily temperatures, both are dependent on the user input fuel RVP, and the fractions of vehicles assumed to experience hot soaks and diurnal emission generation cycles are based on analysis of a large amount of detailed trip information. Each of these changes results in more accurate and realistic evaporative emission factors, and each is discussed briefly below.

The temperature and volatility dependencies of hot soak evaporative emissions are based on the results of emission factor testing of vehicles at several different temperatures and using fuels of differing volatilities. Correction factor equations were developed through regression analysis, and the resulting correction factors are applied to the standard FTP hot soak emission rates. As discussed in section 1.1.4, the temperature used for the correction of hot soak emission rates is based on the minimum and maximum daily temperatures input by the user.

Diurnal emissions as a function of temperature and volatility are developed through the use of the uncontrolled diurnal index (UDI), which expresses diurnal emissions for a given temperature range and fuel volatility as a multiple of standard FTP diurnal emissions. The UDI model and its development are described in more detail in the regulatory support document for the Notice of Proposed Rulemaking regarding in-use fuel volatility control.* Adjustments are included to account for the effects of average in-use fuel tank levels and the effects of in-use fuel weathering, further improving the accuracy of the evaporative emission factors.

The last major change in the calculation of evaporative emission rates concerns the assumptions made as to the number and types of hot soak and diurnal emission cycles experienced by vehicles. Diurnal emissions are generated when the vehicle is not driven during a period characterized by rising ambient temperatures, while hot soak emissions are generated at the completion of every trip.

Standard FTP diurnal emission rates represent emissions generated during a 24 F° temperature rise, from 60° to 84°F. This is not representative of many vehicles' travel patterns: Some vehicles are driven so many times in a day that they never have the opportunity to experience diurnal emissions; some are driven in patterns such that they experience diurnal emissions over much smaller temperature rises than 24 F°; and some vehicles are not driven at all for two, three, or more consecutive days, leading to the generation of diurnal evaporative emissions sufficient to overwhelm canister capacity (since the canister is not purged when the vehicle is not driven), and thus experience diurnal emissions that approach or reach uncontrolled (i.e., no evaporative control canister) levels. This variation in travel patterns has been incorporated into the emission rates calculated by MOBILE4.

On the basis of analyzing detailed trip pattern information from a large data base (1979 National Purchasing Diary), estimates have been developed for the fraction of vehicles that experience no hot soak emissions in a given day, that experience one full diurnal emissions cycle (characterized by a temperature rise corresponding to the input maximum daily temperature minus the input minimum daily temperature), that experience "multiple" diurnal emission cycles (on the second or greater consecutive day of no driving), and that experience "partial" diurnal emission cycles (e.g., a vehicle that is driven three times in one day, between 7 and 7:30 AM, again between 12:30 and 1:00 PM, and finally between 6:00 and 7:00 PM, and thus experiences two diurnal emission cycles, neither of which is characterized by a temperature rise as great as that determined as the difference in the daily maximum and minimum temperatures).

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* "Draft Regulatory Impact Analysis for Control of Gasoline Volatility and Evaporative Hydrocarbon Emissions from New Motor Vehicles," U.S. EPA, OAR, OMS, July 1987; pp. 2-54 to 2-71.

The hot soak and diurnal emissions characteristic of these different travel patterns are calculated by MOBILE4 and then weighted together by the fractions of the fleet that experience each type of condition, based on the trip pattern data base mentioned above. Partial diurnal emissions are calculated on the basis of the input minimum and maximum daily temperatures and the typical variation in temperature over the course of the day. Multiple diurnal emissions are estimated on the basis of uncontrolled diurnal emission rates for vehicles of different types and model year groups. The net result is a considerably more complicated set of calculations, but also a more accurate representation of evaporative emissions in real-world situations.

1.1.12 Tampering Effects on Emissions

Several changes have been made in the way that MOBILE4 determines tampering rates and corresponding emissions offsets. Three such revisions are described below.

An eighth type of tampering, missing gas caps, has been added to the list of tampering types for which rates of occurrence and corresponding emission offsets are calculated. The list of tampering types modeled in MOBILE4 is:

1) air pump disablement
2) catalyst removal
3) overall misfueling
4) fuel inlet restrictor disablement
5) EGR system disablement
6) evaporative control system disablement
7) PCV system disablement
8) missing gas caps.

As described in section 2.2.1, tampering rates are modeled in an analogous manner to the modeling of basic emission rates, with a zero-mile level (y-intercept) and deterioration rate (slope), which together describe the rate of each type of tampering as a function of vehicle accumulated mileage. EPA's tampering survey data show that the rates of some types of tampering increase at an increasing rate after 50,000 miles accumulated mileage. Thus for LDGVs and LDGTs, there are two deterioration rates, one applicable to accumulated mileage up to 50,000 miles and one to accumulated mileage over 50,000 miles.

For some types of tampering, the tampering survey data also show that distinctly different rates of tampering are seen in 1980 and earlier model year vehicles and in 1981 and later model year vehicles. This is reflected where applicable in the tampering rates used in MOBILE4.

1.1.13 Anti-Tampering Programs

The modeling of anti-tampering program emission benefits has been revised in MOBILE4. The list of program specifications that is required of the user in order to model the benefits of such programs has been revised. The following items must be specified by the user:

- Start year (calendar year in which the program begins)
- First (earliest) and last (most recent) model years of vehicles subject to the program
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Program type (centralized or decentralized)
- Frequency of inspection (annual or biennial)
- Compliance rate (percent)
- Inspections performed (air system, catalyst, fuel inlet restrictor, tailpipe lead deposit test, EGR system, evaporative system, PCV, gas cap)

In MOBILE3, the user was also required to supply to the program as input a set of anti-tampering emission credit matrices. This is no longer required in MOBILE4, which contains subroutines that generate the necessary credit matrices on the basis of the program information specified by the user.

See section 2.2.6 and Appendix 2A for additional information.

1.1.14 Inspection/Maintenance Programs

Several changes have also been made in MOBILE4 to the modeling of I/M program emission benefits. The list of program specifications that is required of the user in order to model the benefits of such programs has been revised. The following items must be specified by the user:

- Program start year (calendar year that program begins)
- Stringency level (percent)
- First (earliest) and last (latest) model years of vehicles subject to the requirements of the program
- Waiver rates (percent of failed vehicles; one rate applicable to pre-model year 1981 vehicles and one applicable to 1981 and later model year vehicles)
- Compliance rate (percent)
- Program type (centralized; decentralized and computerized; or decentralized and manual)
- Frequency of inspection (annual or biennial)
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Test type (idle, 2500/idle, loaded/idle)
- Whether or not alternate I/M credits are to be supplied for each of two technology groups (Tech I-II, Tech IV+)

All standard low-altitude I/M program benefits are contained in the MOBILE4 code. Standard I/M program benefits for high-altitude areas are contained on the MOBILE4 tapes supplied by EPA. For other types of programs, EPA must be contacted for assistance in developing the appropriate emission credits. For additional information, see section 2.2.5 and Appendix 2A.

1.3 LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

There are a large number of abbreviations and acronyms used throughout this document. While efforts have been made to define all abbreviations and acronyms the first time that they appear, readers may find the following alphabetized reference list useful. Further information on those abbreviations representing MOBILE4 control flags and other variable names appears in the sections listed at the end of those definitions.

A/C or **AC**	Air conditioning, air conditioner
ALHFLG	Control flag for application of optional additional corrections to light-duty gasoline-fueled vehicle emission factors (section 2.1.10)
alt	Altitude
amb	Ambient
AMBT	Variable name for user-specified ambient temperature (section 2.3.4)
ANSI	American National Standards Institute
AP	Airport
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
ASTMCL	Variable name for ASTM fuel volatility class (section 2.2.10)
ATP	Anti-tampering program
ATPFLG	Control flag for determination of whether effects of an ATP on emission factors is to be modeled (section 2.1.11)
BER	Basic emission rate
bpi	Bytes per inch
CO	Carbon monoxide
CPU	Central processing unit
CY	Calendar year; also, variable name for calendar year of evaluation (section 2.3.2)
DB	Dry bulb temperature
deg	Degree(s)
DR	Deterioration rate
DR1	Deterioration rate applicable up to 50,000 miles accumulated mileage

DR2	Deterioration rate applicable after 50,000 miles accumulated mileage
e.f. or EF	Emission factor(s)
EGR	Exhaust gas recirculation
EPA	Environmental Protection Agency
ft	Feet
FTP	Federal Test Procedure
FTS	Federal telephone system
°F	Degrees Fahrenheit
g/BHP-hr	Grams per brake horsepower-hour
g/hr	Grams per hour
g/mi	Grams per mile
g/min	Grams per minute
GVW	Gross vehicle weight
HC	Hydrocarbon(s)
HCFLAG	Control flag for determination of HC emission factors to be included in output (section 2.1.19)
HDD or HDDV	Heavy-duty diesel vehicle(s) (over 8,500 lbs GVW)
HDG or HDGV	Heavy-duty gasoline-fueled vehicle(s) (over 8,500 lbs GVW)
HDV	Heavy-duty vehicle(s)
ICEVFG	Control flag in MOBILE3; replaced by HCFLAG
IDLFLG	Control flag for output of idle emission factors (section 2.1.17)
IFORM	Control flag in MOBILE3; replaced by OUTFMT
I/M	Inspection and maintenance
IMFLAG	Control flag for determination of whether effects of an I/M program on emission factors is to be modeled (section 2.1.9)
Int'l	International
I/O	Input/Output
IOUNEW	Input record for reassignment of I/O units (section 2.1.2)
JCL	Job control language
K	Thousand(s) (e.g., 50K = 50,000)
kg	Kilogram(s)
LAP	Local area parameter (record) (section 2.2.8)
lb, lbs	Pound(s)
LDD	Light-duty diesel(s)
LDDT	Light-duty diesel truck(s) (0-8500 lbs GVW)
LDDV	Light-duty diesel vehicle(s)
LDG	Light-duty gas

LDGT	Light-duty gasoline-fueled truck(s) (0-8500 lbs GVW)
LDGT1	LDGT(s) up to 6,000 lbs GVW
LDGT2	LDGT(s) 6,001-8,500 lbs GVW
LDGV	Light-duty gasoline-fueled vehicle(s)
LDT	Light-duty truck(s)
LDV	Light-duty vehicle(s)
LOCFLG	Control flag for location of local area parameter record in input stream (section 2.1.13)
max	Maximum
MC	Motorcycle(s)
min	Minimum
MPD	Miles per day
mph	Miles per hour
MSL	Mean sea level
MVMA	Motor Vehicle Manufacturer's Association
myg	Model year group
MY or MYR	Model year(s)
MYMRFG	Control flag for input of annual mileage accumulation rate data or registration distribution data (section 2.1.7)
NAAQS	National Ambient Air Quality Standard
NEWFLG	Control flag indicating whether user is entering modifications to BERs (section 2.1.8)
NIPER	National Institute for Petroleum and Energy Research
NMHC	Non-methane hydrocarbons
NMHFLG	Control flag indicating whether total HC or NMHC emission factors are to be calculated (section 2.1.18)
NOx	Oxides of nitrogen
NTIS	National Technical Information Service
OAR	Office of Air and Radiation
OEM	Original equipment manufactured/manufacturer
OMS	Office of Mobile Sources
OUTFMT	Control flag indicating type of formatted output report to be produced (section 2.1.15)
PC	Personal computer(s)
PCCC	Variable name for percent of VMT accumulated by catalyst-equipped vehicles in cold-start mode (section 2.3.5)
PCCN	Variable name for percent of VMT accumulated by non-catalyst vehicles in cold-start mode (section 2.3.5)
PCHC	Variable name for percent of VMT accumulated by catalyst-equipped vehicles in hot-start mode (section 2.3.5)
PCV	Positive crankcase ventilation
PROJID	Variable name for MOBILE4 run title (section 2.1.3)

PROMPT	Control flag indicating whether user will be prompted for remaining MOBILE4 input (section 2.1.1)
PRTFLG	Control flag indicating which pollutants are to be included in output (section 2.1.16)
psi	Pounds per square inch
R	Refueling HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2)
Reg	Region
RLFLAG	Control flag indicating how refueling emission are to be calculated (section 2.1.12)
rpm	Revolutions per minute
RVP	Reid vapor pressure
SIP	State Implementation Plan
SPDFLG	Control flag indicating how average vehicle speed is to be specified (section 2.1.5)
T	Running loss HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2)
TAMFLG	Control flag indicating whether alternate tampering rates are to be input (section 2.1.4)
TCF	Temperature correction factor
Tech I-II and Tech IV+	Technology groupings of vehicles for which different I/M emission credits have been developed (section 2A.1.15)
TEMFLG	Control flag indicating how temperatures for use in correcting emission factors are to be determined (section 2.1.14)
temp	Temperature(s)
TPD	Trips per day
ub	Upper bound
UDI	Uncontrolled diurnal index
V	Evaporative HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2)
veh	Vehicle(s)
VMFLAG	Control flag indicating whether alternate VMT mix(es) will be input (section 2.1.6)
VMT	Vehicle miles travelled
VRS	Vapor recovery system
WB	Wet bulb temperature
X	Exhaust HC emission factor label in numeric formatted output reports (sections 3.3.1, 3.3.2)
ZML	Zero-mile level

Chapter 2

MOBILE4 INPUTS

2.0 INTRODUCTION

The reader is strongly encouraged to refer to the examples in Chapter 5 when reading this chapter. The examples provide illustrations of the use of MOBILE4 options and data input requirements.

MOBILE4 utilizes one input data set that provides program control information and the data describing the scenarios for which emission factors are to be estimated. The input data set consists of three distinct sections: the Control section, the One-time data section, and the Scenario section. (In previous versions of the User's Guide, the Scenario section was referred to as the Parameter section.)

The Control section is the portion of the input data that controls the input, output, and execution of the program. For example, the Control section indicates whether MOBILE4 will prompt the user for input data, or analyze a scenario that includes an inspection and maintenance program, or output the emission factors in a format suitable for visual inspection or in a format suitable as input for another program.

Certain of the parameters used in the emission factor calculations have internal, or default, values built into MOBILE4. The One-time data section is the portion of the input data that allows the user to define parameter values different from those internal to MOBILE4, which will be used in the calculations for all of the scenarios within a given run. For example, in the One-time data section the user can specify annual mileage accumulation rates or registration distributions by age for each vehicle type.

The Scenario section is the portion of the MOBILE4 input data that details the individual scenarios for which emission factors are to be calculated. For example, in the Scenario section the user specifies the calendar year of evaluation, the average speed(s) to be assumed, and the region (low- or high-altitude).

In a few cases, the placement of data in either the One-time data section or the Scenario data section is determined by the setting assigned to a flag in the Control section of the input stream. In such cases, discussion of the variable(s) involved is provided once, in the One-time data section, and that discussion is referenced in the Scenario data section.

The Control section consists primarily of specified values for variables termed flags. In section 2.1 each flag is named, and the range of possible settings for that flag and the resulting action is noted. In the One-time and Scenario data sections (sections 2.2 and 2.3 respectively), the following general format is used. (Depending on the variable being discussed, not every item noted below is included for every variable.)

- Description: A brief description of what the variable means, and how it is used by MOBILE4.

- Options: A summary of choices available to the MOBILE4 user.

- Use in MOBILE4: A description of the value(s) used in MOBILE4 for the variable(s) if the user does not input locality-specific information, where applicable, and discussion of how the information is used in the emission factor calculations.

- Required Information: A specific description of exactly what information is required of the user, where applicable, including format specifications.

- Guidance: Where applicable, EPA's recommendations and suggestions with respect to the determination of user-supplied values for the variable(s) under discussion. Many users of MOBILE4 will be involved in the development of emission inventories and projections for use in the State Implementation Plan (SIP) process. In many cases, there is no single correct answer or recommendation that will be the best answer for all areas. For those using MOBILE4 for SIP-related purposes, it is important that the appropriate EPA Regional Office personnel be kept involved in decisions concerning questionable or controversial assumptions and steps in the modeling.

There are also three appendices to this chapter which provide additional information about some of the variables, their use within MOBILE4, and the determination of locality-specific information for use as input data. All of the tables referred to in the text are grouped together at the end of the chapter for ease of reference by the user.

Questions about the material in this document, and suggestions as to how the MOBILE4 User's Guide may be made clearer and more useful, should be addressed to:

Terry P. Newell (TEB-13)
U.S. EPA Motor Vehicle Emission Laboratory
2565 Plymouth Road
Ann Arbor, MI 48105

(313) 668-4462 or FTS 374-8462

2.1 CONTROL SECTION

The first portion of the input stream for a MOBILE4 run consists of a series of flag settings. These flags control the format (and in some cases the content) of the remainder of the input stream, influence the execution of the program, and determine the content and format of the program's output. Each flag is named, defined, and its possible values listed, along with the effect of each possible setting.

2.1.1 PROMPT

2.1.1.1 Description

This flag determines whether the user will be prompted for the remainder of the input stream, and the arrangement of the remaining Control data section input. This flag was called IPROMT in MOBILE3.

2.1.1.2 Values/Actions

This flag can be set to 1, 2, 3, or 4:

Value	Action
1	No prompting; after PROJID record (see section 2.1.3), vertical format (one value per line/record) used for remainder of Flags input
2	MOBILE4 prompts for each input; vertical format
3	No prompting; after PROJID record, horizontal format (all values on one line/record) used for remainder of Flags input
4	MOBILE4 prompts for each input; horizontal format

It is suggested that the input prompting options (PROMPT = 2 or 4) be used only when the user is uncertain as to the order of the remaining inputs in the Control data section.

2.1.2 IOUNEW

2.1.2.1 Description

The IOUNEW flag allows reassignment of output unit device numbers. There are three different types of program output, and the default value for all three is unit 6.

2.1.2.2 Values/Actions

The three types of program output are: formatted reports (emission factor results), diagnostic messages (error and warning messages), and prompting messages (such as are issued if the value of the PROMPT flag described above is 2 or 4). Single integer values representing other I/O device numbers may be assigned for any or all of these, in the order listed. If no device reassignments are desired, these fields may be left blank.

Values of 1, 2, 3, 6, 7, and 8 are allowed by MOBILE4 for assignment of any of the three possible output units. Values of 4 and 5 are reserved as input device codes in MOBILE4, and thus may not be assigned by the user for any IOUNEW field. If an illegal or missing IOUNEW value is encountered, MOBILE4 will revert to the default value (unit 6). The user is cautioned that IOUNEW values considered valid by MOBILE4 may not be appropriate for a given computer system.

2.1.3 PROJID

2.1.3.1 Description

MOBILE4 provides an 80-character alphanumeric field for the user to input a descriptive title for the MOBILE4 run.

2.1.3.2 Values/Action

The project title is an 80-column blank record. The user may use up to 80 characters for the title, and the character string does not have to be left-justified. Whatever title is input by the user is simply echoed as the heading of the formatted reports section of the program output. If no title is desired by the user, a blank record must be entered here.

2.1.4 TAMFLG

2.1.4.1 Description

This flag provides the option of supplying tampering rates that differ from those included in MOBILE4.

2.1.4.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	Use MOBILE4 tampering rates
2	User supplies tampering rates for eight categories of tampering, for each of the four vehicle types affected by tampering (LDGV, LDGT1, LDGT2, HDGV)

The user-supplied tampering rate data, required if TAMFLG = 2, are placed in the One-time data section. Section 2.2.1 discusses tampering rates as program input.

2.1.5 SPDFLG

2.1.5.1 Description

MOBILE4 requires that vehicle speed be specified as part of the program input, since exhaust emissions vary considerably with speed. This flag provides the option of specifying one speed for all eight vehicle types, or of specifying different speeds for each vehicle type.

2.1.5.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	User supplies one value for speed to be applied to all vehicle types
2	User supplies eight values for speed, one to be applied to each vehicle type

In both cases, the speed input data are placed in the Scenario data section. Section 2.3.3 discusses speed as program input.

2.1.6 VMFLAG

2.1.6.1 Description

The setting of VMFLAG determines the vehicle miles travelled (VMT) mix (fraction of total VMT accumulated by vehicles of each of the eight types) that will be used in MOBILE4 to estimate the composite emission factor for a given scenario.

2.1.6.2 Values/Action

This flag can be set to 1, 2, or 3:

Value	Action
1	Use MOBILE4 VMT mix
2	User supplies a different VMT mix for each scenario
3	User supplies a single VMT mix for all scenarios

If VMFLAG = 2, the VMT mixes are placed in the Scenario data section. If VMFLAG = 3, the VMT mix is placed in the One-time data section. Sections 2.2.2 and 2.3.6 discuss VMT mix as program input.

2.1.7 MYMRFG

2.1.7.1 Description

This flag controls the use of annual mileage accumulation rates by age and registration distributions by age. These parameters define the composition and travel characteristics of the fleet, and so affect the resulting emission factors.

2.1.7.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

Value	Action
1	Use MOBILE4 (national average) annual mileage accumulation rates and registration distributions
2	User supplies annual mileage accumulation rates; use MOBILE4 registration distributions
3	User supplies registration distributions; use MOBILE4 annual mileage accumulation rates
4	User supplies both annual mileage accumulation rates and registration distributions

The input data required if MYMRFG = 2, 3, or 4 are placed in the One-time data section. Section 2.2.3 discusses the input and use of annual mileage accumulation rates and registration distributions.

2.1.8 NEWFLG

2.1.8.1 Description

This flag provides the option of modifying the basic exhaust emission rates by model year.

2.1.8.2 Values/Action

This flag can be set to either 1 or 2:

Value	Action
1	Use MOBILE4 basic exhaust emission rates
2	User supplies one or more modifications to the MOBILE4 basic exhaust emission rates

The user-supplied modifications to the basic emission rates, required if NEWFLG = 2, are placed in the One-time data section. Section 2.2.4 discusses basic exhaust emission rates and their modification by the user.

2.1.9 IMFLAG

2.1.9.1 Description

This flag allows the option of having MOBILE4 include the effects of an operating inspection and maintenance (I/M) program on the emission factors.

2.1.9.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	No I/M program is assumed to be operating
2	User specifies an I/M program and MOBILE4 models its impact on emission rates

The data specifying an I/M program, required if IMFLAG = 2, are placed in the One-time data section. Section 2.2.5 discusses the specification of I/M programs and their use in MOBILE4.

2.1.10 ALHFLG

2.1.10.1 Description

This flag provides the ability to have MOBILE4 correct some exhaust emission factors to account for certain conditions: air conditioning (A/C) usage, extra loading, trailer towing, and humidity. These additional corrections apply only to exhaust emission factors (HC, CO, and NOx), and only to the light-duty gasoline-fueled vehicle types (LDGVs, LDGT1s, and LDGT2s), with the exception that the humidity correction affects only NOx emission factors and is also applied to motorcycle emissions.

2.1.10.2 Values/Action

This flag can be set to 1, 2, or 3:

Value	Action
1	Do not apply these additional correction factors (no additional inputs required)
2	Six additional input values required
3	Ten additional input values required

The additional data required if ALHFLG = 2 or 3 are placed in the Scenario data section. The specific inputs required when ALHFLG = 2 or 3 are discussed in section 2.3.8.

2.1.11 ATPFLG

2.1.11.1 Description

This flag allows for the effects of an operating anti-tampering program (ATP) to be included in the emission factor calculations.

2.1.11.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	No ATP is assumed
2	User specifies an ATP and MOBILE4 accounts for its impact on emission rates

The data specifying the characteristics of the ATP to be modeled, required when ATPFLG = 2, are placed in the One-time data section. Section 2.2.6 discusses user specification of ATPs.

2.1.12 RLFLAG

2.1.12.1 Description

This flag controls whether and how MOBILE4 models refueling emissions from gasoline-fueled vehicles. (These emissions are also referred to as Stage II emissions.) The inclusion of these emissions, and the RLFLAG flag, are new to MOBILE4.

2.1.12.2 Values/Action

This flag can be set to 1, 2, 3, 4, or 5:

Value	Action
1	Use uncontrolled refueling emission rates for all model years
2	Model the impact of Stage II vapor recovery system (VRS) requirement on refueling emissions
3	Model impact of onboard VRS requirement on refueling emissions
4	Model impact of both Stage II and onboard VRS requirements on refueling emissions
5	Zero-out refueling emissions completely (effectively the approach taken in MOBILE3); in this case, Stage II emissions must be accounted for in the stationary source portion of the emission inventory

The data describing the characteristics of either or both vapor recovery systems, required if RLFLAG = 2, 3, or 4, are placed in the One-time data section. Refueling emissions and their modeling in MOBILE4 are discussed in section 2.2.7.

2.1.13 LOCFLG

2.1.13.1 Description

This flag controls the input by the user of the local area parameters (LAP) record. This record contains seven variables (scenario name, ASTM volatility class, minimum and maximum daily temperatures, base RVP, in-use RVP, and in-use start year).

2.1.13.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	User enters a distinct LAP record for each scenario of the MOBILE4 run
2	User enters one LAP record to apply to all scenarios of the MOBILE4 run

If LOCFLG = 1, the LAP records are placed in the Scenario data section. If LOCFLG = 2, the LAP record is placed in the One-time data section. The content of the LAP is discussed in section 2.2.8, and the individual variables comprising the LAP are discussed in sections 2.2.9 through 2.2.13. Table 2.2-5 provides a summary of and specifications for the LAP record in the MOBILE4 input stream.

2.1.14 TEMFLG

2.1.14.1 Description

This flag controls the determination of temperatures to be used in the correction of the exhaust emission factors (HC, CO, and NOx), the hot soak and diurnal components of the evaporative HC emission factors, and the running loss HC emission factors. All of these are dependent on temperature, although in MOBILE3 only the exhaust emission factors were corrected for temperature. This flag and the features it controls are completely new in MOBILE4.

2.1.14.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	MOBILE4 will determine the temperatures to be used in correcting emission factors for temperature effects, on the basis of the user-supplied input values for minimum and maximum daily temperature. The user-supplied input value for ambient temperature will not be used in calculating temperature corrections to emissions if TEMFLG = 1; it will be overridden by specific values calculated individually for exhaust HC, exhaust CO, exhaust NOx, hot soak evaporative HC, and running loss HC.

Value	Action
2	The user-supplied input value for ambient temperature will be used as the basis for calculating the temperature corrections to all exhaust emissions, hot soak evaporative emissions, and running loss emissions. The user-supplied input values for minimum and maximum daily temperature will still be used in calculating diurnal evaporative emissions.

As discussed in sections 1.1.4 and 1.1.11, the temperatures used to correct exhaust, hot soak evaporative, and running loss emissions are determined in a way that accounts for variation in emission levels with daily variation in temperature if TEMFLG = 1. The result is that the temperature corrections will be weighted to reflect average emissions over a period of time (i.e., a day) where the temperature range is from the minimum to the maximum input temperatures. Thus, the use of TEMFLG = 1 is recommended for inventory preparation and SIP-related modeling by the States.

Additional discussion of the use of this new flag and its impact on the emission factor calculations is in section 1.1.4. The input of ambient temperature is discussed in section 2.3.4. The input of minimum and maximum daily temperatures is discussed in section 2.2.11. Additional guidance on the determination of appropriate values for use as temperature inputs to MOBILE4 when the model is being used for SIP-related emission inventory development and attainment planning is provided in Appendix 2-C of this User's Guide.

Table 2.1-1 summarizes the flags controlling the input requirements and execution of MOBILE4.

2.1.15 OUTFMT

2.1.15.1 Description

This flag controls the format structure of the formatted output report. Different formats are appropriate depending on the intended use of the MOBILE4 output. This flag was called IFORM in MOBILE3.

2.1.15.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

Value	Action
1	221-column numerical format
2	140-column numerical format
3	112-column descriptive format
4	80-column descriptive format

The numerical formats are generally used when the output of the MOBILE4 run is to be used as input for another program (e.g., air quality simulations). The descriptive formats contain all of the same information, with more complete labels and headings for ease of visual inspection. Illustrative examples are shown in Chapter 5 (MOBILE4 Examples).

2.1.16 PRTFLG

2.1.16.1 Description

This flag determines which pollutants will have emission factor calculations performed, and thus will be included in the program output. This feature enables the user to avoid the time and expense of calculating all emission factors when the results for only one of the pollutants are all that is necessary for some applications.

2.1.16.2 Values/Action

This flag can be set to 1, 2, 3, or 4:

Value	Action
1	HC (hydrocarbon) emission factors only
2	CO (carbon monoxide) emission factors only
3	NOx (oxides of nitrogen) emission factors only
4	All three pollutants

2.1.17 IDLFLG

2.1.17.1 Description

This flag controls the calculation and output of idle emission factors (emissions at idle in terms of mass pollutant per unit time (g/hr) for each pollutant).

2.1.17.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	No idle emission factors calculated or printed (exhaust emission factors only)
2	Idle emission factors calculated and printed (in addition to exhaust emission factors)

2.1.18 NMHFLG

2.1.18.1 Description

This flag determines whether the HC emission factors will be calculated on the basis of total hydrocarbons (including methane), or only for non-methane hydrocarbons (NMHC). This feature is useful when only reactive (i.e., non-methane) HC emission factors are desired.

2.1.18.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	Total hydrocarbon emission factors
2	Non-methane hydrocarbon emission factors

2.1.19 HCFLAG

2.1.19.1 Description

This flag determines whether the HC emission factors in the output will include only the total HC emissions (whether total or non-methane, as discussed above), or will also include component emission factors (exhaust, evaporative, refueling, running loss, and total HC emissions). This flag is new in MOBILE4, and provides the user one of the options previously accessed through the ICEVFG flag, which no longer exists.

2.1.19.2 Values/Action

This flag can be set to 1 or 2:

Value	Action
1	No component output (print only total HC)
2	Print components (exhaust, evaporative, refueling, running loss, and total HC)

Table 2.1-2 summarizes the flags controlling the output of MOBILE4.

2.1.20 Inter-Flag Dependencies

2.1.20.1 Description

There are cases where the value assigned to one flag in the Flags section either determines the value that must be assigned to another flag, or precludes the use of one or more possible values for another flag. Certain combinations of flag settings also impose requirements on other inputs in either the One-time or Scenario data sections. While careful consideration of the inputs prepared for a MOBILE4 run makes such situations clear, a short listing is provided here for the convenience of the user.

2.1.20.2 List

2.1.20.2.1 If TAMFLG = 2 (user-supplied tampering rates) and IMFLAG = 1 (no I/M program assumed), supply only one set of alternate tampering rates (non-I/M rates).

2.1.20.2.2 If TAMFLG = 2 and IMFLAG = 2 (specify and model an I/M program), two sets of alternate tampering rates must be supplied (both non-I/M and I/M rates).

2.1.20.2.3 If PRTFLG = 2 or 3 (no HC emission factors requested), then the flags dealing with details of the HC emission factor calculation should be set as follows: NMHFLG = 1, HCFLAG = 1, and RLFLAG = 5.

2.1.20.2.4 Conversely, if NMHFLG = 2 (calculate non-methane HC emission factors) and/or HCFLAG = 2 (print components of HC emission factor) and/or RLFLAG = 1, 2, 3, or 4 (calculate refueling emissions), then PRTFLG = 1 or 4 is necessary.

This concludes the Control data section.

2.2 ONE-TIME DATA SECTION

As suggested by its name, the One-time data section contains information which is input only once in MOBILE4. This input information is used to alter internal MOBILE4 estimates to be locality-specific. For example, a user can incorporate VMT mix, mileage accumulation, and/or registration distributions that are specific to the area of concern. These records are all optional, their use being dictated by the values of some of the flags in the Control section. (Thus, in some MOBILE4 runs the One-time data section will not be included in the input sequence.) If any of these records are included in the input, they follow immediately after the Control section, in the order in which they are described below.

The One-time data section must be included if one or more of the following MOBILE4 options are selected:

1. The user wishes to input local tampering parameters (TAMFLG = 2).
2. The user wishes to supply a VMT mix which will be applied to all emission factor calculations (VMFLAG = 3).
3. The user wishes to use local mileage accumulation and/or registration distributions by age (MYMRFG = 2, 3, or 4).
4. The user wishes to modify the basic exhaust emission rates used in the calculation of the emission estimates (NEWFLG = 2).
5. The user wishes to include Inspection/Maintenance credits in the emission factor calculations (IMFLAG = 2).
6. The user wishes to include the effects of an anti-tampering program in the emission rates (ATPFLG = 2).
7. The user wishes to include the effects of Stage II or onboard vapor recovery systems on the refueling HC emission factors (RLFLAG = 2, 3, or 4).
8. The user wishes to have the same local area parameter (LAP) record input values applied to all scenarios of a MOBILE4 run (LOCFLG = 2).

The data requirement order in the One-time data section is the same order as the associated flags in the Control section.

2.2.1 TAMPERING RATES

2.2.1.1 Description

MOBILE4 calculates tampering rates as a piecewise linear function of accumulated mileage for each gasoline-fueled vehicle type (LDGV, LDGT1, LDGT2, and HDGV) and for eight types of tampering (air pump disablement, catalyst removal, overall misfueling, fuel inlet restrictor disablement, EGR system disablement, evaporative control system disablement, PCV system disablement, and missing gas caps). These rates are combined with the corresponding fractions of vehicles equipped with the given control technology and the emissions impact rates to obtain the tampering offsets (the increase in emissions that results from the given type of tampering). These offsets are subsequently added to the non-tampered emission factors.

2.2.1.2 Options

MOBILE4 uses tampering rates based on OMS analysis of multi-city tampering survey results if no locality-specific rates are supplied as input (TAMFLG = 1). **The use of the rates included in MOBILE4 is recommended.**

Provisions exist within MOBILE4 for the input of alternate tampering rates (TAMFLG = 2). EPA has determined through its tampering surveys that tampering rates are lower in areas with operating inspection and maintenance (I/M) programs than in areas without such programs, and are lower after an I/M program is implemented in a given area than in the same area before the program begins operation. Thus, if TAMFLG = 2 and IMFLAG = 1, the user must supply one set of alternate rates, representing the case where no inspection and maintenance (I/M) program is in effect. If TAMFLG = 2 and IMFLAG = 2, the user must supply two sets of alternate rates, representing both the non-I/M and I/M cases. **Before approving the use of alternate tampering rates, EPA must review and approve of the tampering survey(s) on which such rates are based.**

2.2.1.3 MOBILE4 Tampering Rates

MOBILE4 uses two or four rate equations for each type of tampering stored within the model, for each of the vehicle types subject to tampering (one each for pre-1981 model year vehicles and for 1981 and later model year vehicles; for either the non-I/M case only, or for both the non-I/M and I/M cases). These rate equations are based on OMS analysis of national tampering survey data.

2.2.1.4 Required Information

The following information is required in order to input alternate tampering rates: For each combination of (vehicle type)/(pre-1981 model year or 1981 and later model year)/(tampering type)/(non-I/M or I/M case), you must supply a zero-mile level (y-intercept) and deterioration rate (slope, or rate of increase in the tampering rate per 10,000 miles accumulated mileage). For 1981 and later model year light-duty gasoline-fueled vehicles (LDGVs) and light-duty gasoline-fueled trucks (LDGT1s and LDGT2s), a second deterioration rate is also required that defines the rate of increase in the tampering rates for such vehicles after 50,000 miles accumulated mileage. All values must be in fractional units.

The required format for each of the sets of rates (either one or two sets, as discussed in section 2.2.1.2) is:

For pre-1981 model year vehicles:	8F8.4, 8F9.5.
For 1981 and later model year vehicles:	8F8.4, 8F9.5, 8F9.5.

The 8F8.4 record is for the zero-mile levels. The 8F9.5 record(s) are for the deterioration rates. For 1981 and later, two sets of deterioration rates are required (up to 50,000 miles, 50,000 miles and higher accumulated mileage, as discussed above). The order of the tampering types within each record is:

1) air pump disablement
2) catalyst removal
3) overall misfueling
4) fuel inlet restrictor disablement
5) EGR system disablement
6) evaporative control system disablement
7) PCV system disablement
8) missing gas caps.

Thus the complete set of alternate tampering rate data inputs, for the non-I/M case and for the I/M case, consists of a total of 20 records: For each of the four gasoline-fueled vehicle types (LDGV, LDGT1, LDGT2, HDGV, in that order), there are four records, except for LDGV there are five:

1)	ZML for pre-1981 model year vehicles	(8F8.4)
2)	DR for pre-1981 model year vehicles	(8F9.5)
3)	ZML for 1981 and later model year vehicles	(8F8.4)
4)	DR1 for 1981 and later model year vehicles	(8F9.5)
5)	DR2 for 1981 and later model year vehicles	(8F9.5)

where DR1 are applied up to 50,000 miles accumulated mileage and DR2 are applied after 50,000 miles accumulated mileage for LDGVs (for other vehicle types, DR1 is applied regardless of mileage).

2.2.1.5 Guidance

For guidance regarding EPA approval of tampering surveys and the development of tampering rates based on such surveys, contact the Office of Mobile Sources (Field Operations and Support Division, 202/382-2633 or FTS 382-2633).

2.2.2 VEHICLE MILES TRAVELLED MIX by vehicle type

2.2.2.1 Description

The vehicle miles travelled (VMT) mix specifies the fraction of total highway VMT that is accumulated by each of the eight regulated vehicle types. The VMT mix is used by MOBILE4 only to calculate the composite (all vehicle, or fleetwide) emission factor for a given scenario from the eight vehicle-class-specific emission factors.

2.2.2.2 Options

You can choose between the use of the MOBILE4 national VMT mix (VMFLAG = 1), the input of one locality-specific VMT mix for use in all scenarios of a given MOBILE4 run (VMFLAG = 3), or the input of a distinct locality-specific VMT mix for each scenario (VMFLAG = 2).

For inventory construction purposes, EPA generally will requires states to develop and use their own specific estimates of VMT by vehicle type. In such cases, VMT fractions based on those estimates of VMT by vehicle type should be calculated and used here as input.

2.2.2.3 MOBILE4 VMT Mix

MOBILE4 calculates the VMT mix based on national data characterizing registration distributions and annual mileage accumulation rates by age for each vehicle type, diesel sales fractions by model year (for LDVs and LDTs only), total HDDV registrations and annual mileage accumulations by weight class, and total vehicle counts (fleet size) by vehicle type. Considering the dependance of the VMT mix on the annual mileage accumulation rates and registration distributions by age (see section 2.2.3), the use of the MOBILE4 VMT mix is generally recommended in cases where the focus is on direct comparison of emission factors under different assumptions.

As noted above, for inventory construction states will generally develop and apply their own estimates of VMT by vehicle type. The use of an alternate VMT mix will result in minor internal inconsistencies; for example, assumptions concerning the gas/diesel split of LDVs that are used in the emission factor calculations will not be altered through the use of different VMT fractions for LDGVs and LDDVs. However, such inconsistencies will not significantly affect inventory construction unless the inventory is based only on the fleetwide composite emission factor and total mobile source VMT. Inventory construction based on vehicle-type-specific emission factors and VMT estimates, as EPA will require of States for SIP purposes, will not use the composite fleetwide emission factor.

2.2.2.4 Required Information

Each VMT mix supplied as input must consist of a set of eight fractional values, representing the fraction of total mobile source VMT accumulated by each of the eight vehicle types. All values must be between zero and one ($0.0 \leq$ VMT fraction for any vehicle type ≤ 1.0), and the eight values must sum to 1.0 (MOBILE4 will output an error message and will not execute the run if these constraints are not met).

The format of the VMT mix record(s) is 8F4.3. The values correspond to the eight vehicle types in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC.

2.2.2.5 Guidance

Techniques for calculating estimated VMT by vehicle type (and thus, total VMT and the VMT mix fractions) from available data sources are described in Chapter 6 of the report, "Techniques for Estimating MOBILE2 Variables."*

2.2.3 ANNUAL MILEAGE ACCUMULATION RATES and/or REGISTRATION DISTRIBUTIONS by vehicle type and age

2.2.3.1 Description

MOBILE4's emission factor calculations incorporate estimates of the average annual mileage accumulation by age (first year to 20th-and-greater years of operation) for each of the eight vehicle types, and the registration distribution by age (age 0-1 to age 19-20+) for each vehicle type, except motorcycles, for which annual mileage accumulation rates and registration distributions are only provided for the first to 12th-and-greater years of operation (ages 0-1 to 11-12+).

2.2.3.2 Options

MOBILE4 uses national average annual mileage accumulation rates by age and registration distributions by age, and has provisions allowing the input of locality-specific data for either or both of these. The use of the annual mileage accumulation rates by age included in MOBILE4 is strongly recommended. Users may develop registration distributions by age on the basis of locality-specific data.

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* See section 2.5 for information on obtaining referenced reports.

2.2.3.3 MOBILE4 Annual Mileage Accumulation Rates and Registration Distributions

If you do not provide locality-specific mileage accumulation rates and/or registration distributions by age, MOBILE4 uses national average values.

This information is used for all calendar years evaluated, and is based on analyses of information developed over a long period of time. Due to the importance of this information in characterizing the in-use fleet, the need to avoid basing such information on data collected over a short period of time (thereby increasing the risk of reflecting atypical or cyclical use or sale patterns), and the inherent difficulty of developing accurate locality-specific data describing annual mileage accumulation rates by age, the use of the MOBILE4 annual mileage accumulation rates by age is recommended. The use of locality-specific data to derive registration distributions by age may be appropriate for some applications, particularly where such data reflect significant differences from the national average.

If local annual mileage accumulation rates or registration distributions are used, they normally should not change across calendar years. In particular, EPA will not accept SIP-related modeling that includes assumptions that the vehicle fleet will be newer (have a lower average age) in the future than is reflected in the MOBILE4 registration distributions. Modeling that assumes no further aging of the fleet from the current characterization will be accepted by EPA for SIP purposes.

2.2.3.4 Required Information

These records are required if MYMRFG = 2, 3, or 4 (see section 2.1.7).

To use locality-specific annual mileage accumulation rates by age, a total of 160 input values are required: the estimated annual mileage accumulated by vehicles of each of the eight types for each of 20 ages (except 12 ages for motorcycles; use 0.0 as the annual mileage accumulation rate for motorcycles of ages 13 through 20). These values are input as miles divided by 10,000 (e.g., 12,637 miles is input as 0.12637).

To use locality-specific registration distributions by age, again a total of 160 input values are required. For each vehicle type, a set of 20 values (except 12 values for motorcycles; use 0.0 as the registration distribution for motorcycles of ages 13 through 20) are required to represent the fraction of all vehicles of the given type that are of a given age.

Any individual value must be between zero and one. The values for LDGVs and LDDVs must be equal, and the values for LDGT1s and LDDTs must be equal. MOBILE4 uses an internal function to separate these pairs of vehicle types into distinct gas and diesel distributions, based on diesel sales fractions by model year. Thus, the sums of either of these two sets of values:

LDGV + LDGT1 + LDGT2 + HDGV + HDDV + MC
or
LDGT2 + HDGV + LDDV + LDDT + HDDV + MC

should equal 1.0.

In addition, in the case where you supply both the annual mileage accumulation rates by age and the registration distributions by age, the annual mileage accumulation rate corresponding to any vehicle type/age combination accounting for a non-zero fraction of registrations must be positive (i.e., if vehicles of a certain type and age exist in the fleet, then they must accumulate some mileage). If these constraints are not met, MOBILE4 will generate one or more error messages and the run will be aborted.

The annual mileage accumulation rates are entered as 16 records, each of 10F7.5 format. Registration distributions by age are also entered as 16 records, each of 10F5.3 format. If both annual mileage accumulation rates and registration distributions are being supplied by the user, the annual mileage accumulation rates precede the registration distributions (16 records of format 10F7.5 followed by 16 records of format 10F5.3).

In both cases, the 16 records represent 2 records per vehicle type for each of the eight vehicle types, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, and MC. Each of the two records per vehicle type contains the annual mileage accumulation rate by age, or the registration distribution by age, as follows:

First record - age 1, age 2, age 3, . . . , age 10
Second record - age 11, age 12, age 13, . . . , age 20+.

2.2.3.5 Guidance

Methods for estimating the annual mileage accumulation rates by age and the registration distributions by vehicle type and age are presented in Chapters 2 and 3, respectively, of the report "Techniques for Estimating MOBILE2 Variables."

2.2.4 BASIC EMISSION RATES

2.2.4.1 Description

The basic emission rates (BERs) in MOBILE4 are expressed in the form of equations, consisting of a zero-mile level (ZML) (y-intercept) and deterioration rate (DR) (slope, or increase in emissions per 10,000 miles accumulated mileage). The units used for all vehicle types except heavy-duty vehicles (HDGV, HDDV) are grams per mile (g/mi) for the ZMLs and g/mi per 10,000 miles (g/mi per 10K mi) for the DRs. For HDGVs and HDDVs, the units are grams per brake horsepower-hour (g/BHP-hr). There are different BER equations in MOBILE4 for each vehicle type/pollutant/model year group, with the model year groups defined on the basis of applicable emission standards and control technologies used.

A feature new to MOBILE4 is the inclusion of two different deterioration rates in each BER equation for certain vehicle types and model year groups. In each such BER equation, there is one DR applicable to mileage accumulated between zero and 50,000 miles, and a second (higher) DR applicable to mileage accumulated beyond 50,000 miles. This feature is applicable only to 1981 and later model year LDGVs.

2.2.4.2 Options

MOBILE4 provides the capability to input alternate BER equations (NEWFLG = 2). However, the BERs in MOBILE4 accurately reflect all promulgated emission standards; **no locality-specific changes to these equations are warranted**. The option of alternate BERs is intended for use **only** in the situation where new or revised emission standards are promulgated by EPA after the release of MOBILE4.

2.2.4.3 MOBILE4 Basic Emission Rates

The BER equations in MOBILE4 are based on the applicable Federal emission standards and the emission control technologies characterizing the fleet in various model years (for example, different types of catalytic converters exhibit different rates of deterioration). These equations are applicable for all non-California areas, both low- and high-altitude, and **should not be altered by the user without EPA guidance**.

2.2.4.4 Required Information

If alternate BER equations are to be used, the information that must be supplied includes: the number of alternate BER equations that are to be entered, the region (low- or high-altitude) to which the alternate BERs apply, the vehicle type(s) affected, the first and last model years for which the alternate equations apply, the ZML (g/mi), and the DR (g/mi per 10K mi).

If the vehicle type affected is 1981 and later model year LDGVs, then two DRs (one for accumulated mileage up to 50,000 mi and one for accumulated mileage beyond 50,000 mi) must be supplied. This is new in MOBILE4. If the vehicle type affected is HDGV or HDDV, units of g/BHP-hr must be used for both ZML and DR. This is also new in MOBILE4, which will convert the g/BHP-hr rates to g/mi rates internally.

The new BER input must consist of a set of **N+1** records, where **N** is the number of new BERs (records) that follow the first record. The maximum number of new BERs permitted in a MOBILE4 run is 100. In addition, for each combination of region/vehicle type/pollutant, no more than 12 new BERs are permitted. The format specifications, allowable ranges, and codes for these records are summarized in Table 2.2-1.

2.2.4.5 Guidance

If you require the use of alternate BER equations in the future, you should contact the Office of Mobile Sources for additional guidance (Test and Evaluation Branch, 313/668-4325 or FTS 374-8325).

2.2.5 INSPECTION AND MAINTENANCE PROGRAMS

2.2.5.1 Description

Many areas of the country have implemented inspection and maintenance (I/M) programs as a means of further reducing mobile source air pollution. MOBILE4 has the capability of modeling the impact of an operating I/M program on the calculated emission factors.

2.2.5.2 Options

The user has the option of either accounting for the effects of an I/M program (IMFLAG = 2), or of assuming that there is no I/M program in effect (IMFLAG = 1). Standard low-altitude area emission reduction credits are contained in the MOBILE4 code, and standard high-altitude area emission credits are included as a separate file on the MOBILE4 tape. The model is also capable of accepting alternate credit matrices developed by EPA as input data.

2.2.5.3 Required Information

If IMFLAG = 2, all of the following I/M program parameters must be specified by the user, in the order shown:

- Program start year (calendar year that program begins)
- Stringency level (percent)
- First (earliest) and last (latest) model years of vehicles subject to the requirements of the program
- Waiver rates (percent of failed vehicles; one rate applicable to pre-model year 1981 vehicles and one applicable to 1981 and later model year vehicles)
- Compliance rate (percent)
- Program type (centralized; decentralized and computerized; or decentralized and manual)
- Frequency of inspection (annual or biennial)
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Test type (idle, 2500/idle, loaded/idle)
- Whether or not alternate I/M credits are to be supplied for each of two technology groups (Tech I-II, Tech IV+)

The format of this record is:

```
4(I2,1X),2(F2.0,1X),F3.0,1X,2(I1,1X),4I1,1X,I1,1X,2I1.
```

Table 2.2-2 summarizes the I/M descriptive input record required if IMFLAG = 2, including the codes and allowable values for each field of the record. See Appendix 2A of this chapter for more detailed discussion of each of the parameters listed above.

2.2.5.4 Guidance

Additional information on the modeling of I/M program benefits in MOBILE4 is provided in Appendix 2A. For those cases where the emission reduction credit matrices included with MOBILE4 are inappropriate for the I/M program being modeled, contact the Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 374-8367) to obtain the required matrices.

2.2.6 ANTI-TAMPERING PROGRAMS

2.2.6.1 Description

Some areas of the country have implemented anti-tampering programs (ATPs) to reduce the frequency and resulting emission impact of emission control tampering (e.g., misfueling, disablement or removal of catalytic converters). MOBILE4 allows the user to include the effects of such a program on the calculated emission factors.

2.2.6.2 Options

You can choose to model the effects of an ATP on the emission factors (ATPFLG = 2), or to assume that no ATP is in effect (ATPFLG = 1). The information required of the user if ATPFLG = 2 is discussed below. MOBILE4 contains a subroutine that will generate the applicable emission factor credit matrices based on the information that you provide on the characteristics of the ATP. This is significantly different from MOBILE3, which required that the emission factor credit matrices be supplied as part of the input data.

2.2.6.3 Required Information

The following must be specified by the user in order to have MOBILE4 model the effects of an ATP, in the order shown:

- Start year (calendar year in which the program begins)
- First (earliest) and last (most recent) model years of vehicles subject to the program
- Whether or not each of four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are covered by the program
- Program type (centralized or decentralized)
- Frequency of inspection (annual or biennial)
- Compliance rate (percent)
- Inspections performed (air system, catalyst, fuel inlet restrictor, tailpipe lead deposit test, EGR system, evaporative system, PCV, gas cap)

The format of this record is:

```
3(I2,1X),4I1,1X,2I1,1X,F4.0,1X,8I1.
```

Table 2.2-3 summarizes the ATP descriptive input record required if ATPFLG = 2, including the variable names, codes, and allowable values for each field of the record. See Appendix 2A of this chapter for more detailed discussion of each of the parameters listed above.

2.2.6.4 Guidance

Additional information on the modeling of ATP program benefits in MOBILE4 is provided in Appendix 2A. Further guidance on developing the information required to model the emissions impact of an ATP can be obtained by contacting the Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 382-8367).

2.2.7 REFUELING EMISSIONS

2.2.7.1 Description

The refueling of gasoline-fueled vehicles results in the displacement of fuel vapor from the vehicle fuel tank to the atmosphere. These "refueling emissions" have not been accounted for in previous versions of the emission factor model. There are two basic approaches to the control of vehicle refueling emissions, generally referred to as "Stage II" (at the pump) and "onboard" (on the vehicle) vapor recovery systems (VRS). MOBILE4 has the ability to model refueling emissions based on uncontrolled levels (i.e., assuming no requirements for Stage II or onboard VRS systems), as well as assuming implementation of either or both of the major types of VRS.

2.2.7.2 Options

There are five approaches available in MOBILE4 for the modeling of vehicle refueling emissions, depending on the value assigned to RLFLAG:

Value	Action
1	Model uncontrolled refueling emissions for all gasoline-fueled vehicle types.
2	Model refueling emissions assuming a Stage II VRS requirement.
3	Model refueling emissions assuming an onboard VRS requirement.
4	Model refueling emissions assuming both Stage II and onboard VRS requirements.
5	Account for refueling emissions elsewhere in the inventory; no refueling emission factors calculated by MOBILE4.

There are no additional input requirements for the first or last approaches. If you wish to include the effects of either or both VRS requirements on refueling emissions, you must supply certain information to be assumed about the program.

2.2.7.3 Refueling Emissions in MOBILE4

The uncontrolled refueling emission factors in MOBILE4 are based on vehicle test results which were used to develop a regression equation expressing refueling emissions as a function of fuel RVP, temperature of dispensed fuel, and difference in temperatures of dispensed and residual tank fuel. The use of nationwide summertime average values for these parameters yields refueling EFs in terms of grams of vapor emitted per gallon of fuel dispensed (g/gal). Combining this with vehicle fuel economy data (mi/gal) yields refueling emission factors in grams per mile (g/mi).

If you wish to model the effect of a Stage II VRS requirement on these emissions, its in-use control efficiencies (for LDGVs and LDGTs, and for HDGVs) must be entered as input. There are no national average values for Stage II efficiency in MOBILE4. In modeling an an onboard VRS requirement, MOBILE4 assumes a 96 percent reduction in refueling emissions from onboard-equipped vehicles.

2.2.7.4 Required Information

To model the effect of a Stage II VRS requirement, you must provide four inputs: the start year (calendar year in which the requirement takes effect), the phase-in period (number of years for Stage II VRS installation to be completed), and the system efficiency (in percent) at controlling refueling emissions from light-duty vehicles and trucks, and from heavy-duty vehicles.

Modeling the effect of an onboard VRS requirement requires the user to provide only the starting model year and which of the four possible vehicle types (LDGV, LDGT1, LDGT2, HDGV) are subject to the requirement. The effects of the EPA reproposal for a national onboard VRS requirement, due to be published soon, can be modeled by verifying the specifics of the program with EPA (see section 2.2.7.5).

All of the above must be supplied if both VRS requirements are assumed.

The format of the Stage II VRS descriptive record is:

`I2,1X,I1,2(1X,I3).`

The format of the onboard VRS descriptive record is:

`I2,1X,4I1.`

If both records are to be supplied, the Stage II descriptive record precedes the onboard descriptive record. Table 2.2-4 summarizes both of these possible records, including the variable names, codes, and allowable values for each field.

2.2.7.5 Guidance

The overall effectiveness of Stage II VRS at controlling refueling emissions depends on a number of factors, including the baseline efficiency of the system used, the portion of total area gasoline consumption handled by service stations exempt from Stage II requirements, and the frequency and stringency of enforcement programs. In general, the effectiveness of Stage II VRS at controlling refueling emissions will be greater for light-duty vehicles and trucks than for heavy-duty vehicles, since HDGVs are more likely to be refueled at service stations (or other fuel dispensing locations, such as private refueling depots) that will be exempted from Stage II requirements. For assistance in developing such information, contact EPA's Office of Air Quality Planning and Standards (919/541-5397 or FTS 629-5397).

Since any onboard requirement would be a national control program, the only issues are what model year the program will be implemented and whether or not all gasoline-fueled vehicles will be covered. Contact the Office of Mobile Sources (Standards Development and Support Branch, 313/668-4423 or FTS 374-4423) to determine this.

If the user chooses not to model refueling emissions using MOBILE4 (RLFLAG = 5), then these emissions must be accounted for in the stationary source portion of the inventory in the development of the base and projected emission inventories. The effects of an onboard VRS system requirement cannot be modeled if this approach is taken. EPA recommends the use of MOBILE4 to model refueling emissions for SIP-related inventory development and projections.

2.2.8 LOCAL AREA PARAMETER RECORD

2.2.8.1 Description

The local area parameter (LAP) record consists of seven locality-specific input variables, and must be included at least once in every MOBILE4 run.

2.2.8.2 Options

You can choose to use one LAP for all scenarios (LOCFLG = 2) or a different LAP for each scenario (LOCFLG = 1). The same LAP generally should be used for all scenarios (e.g., for different evaluation years) for the same locality, with the exception of the scenario name (see section 2.2.9).

2.2.8.3 Content of the LAP

The following variables comprise the LAP record:

1) Scenario name
2) ASTM volatility class
3) Minimum daily temperature
4) Maximum daily temperature
5) Base RVP
6) In-use RVP
7) In-use RVP start year

Each of these variables is discussed in sections 2.2.9 through 2.2.13, below. Table 2.2-5 summarizes the LAP record, including the content, variable name, codes, and allowable values for each field of the record.

2.2.9 SCENARIO NAME

2.2.9.1 Description

You are provided with 16 character spaces for entering an identifying label for each scenario within a run. This is simply echoed as part of the output.

2.2.9.2 Guidance

If no scenario name is desired, a blank record must be entered here. This record is typically used to define the most important characteristics distinguishing the scenario from others within the same MOBILE4 run (e.g., calendar year of evaluation, inclusion of I/M program).

2.2.10 ASTM VOLATILITY CLASS

2.2.10.1 Description

The nation is divided by the American Society for Testing and Materials (ASTM) into five volatility classes, designated by a letter (A-E), for each month of the year. A recommended maximum fuel volatility (Reid vapor pressure, or RVP) is associated with each letter. Compliance with ASTM volatility limits by the petroleum refining and supply industries is voluntary, but these designations are a reasonably accurate estimation of the average volatility of gasoline in a given area during a given month.

2.2.10.2 Options

The user must input a value for the ASTM volatility class in the base year. This can be any valid ASTM volatility class (A, B, C, D, or E). However, there are specific values assigned by ASTM for each state, or part of state, for each month of the year.

2.2.10.3 Use in MOBILE4

MOBILE4 maps the ASTM volatility class to the corresponding suggested RVP limit, in psi (A --> 9.0, B --> 10.5, C --> 11.5, D --> 13.5, E --> 15.0). This is used to adjust the uncontrolled refueling emission factors contained in MOBILE4 Block Data for fuel volatility other than ASTM Class C (i.e., other than 11.5 psi). It is also used in the modeling of the effects of fuel volatility limiting regulations, which are keyed to the volatility of fuel in ASTM Class C areas with proportional RVP reductions required in other ASTM areas.

2.2.10.4 Required Information

Specification of ASTM volatility class in the form of one of the five letters A/B/C/D/E.

2.2.10.5 Guidance

Fuel volatility primarily affects evaporative HC emissions, which in turn are primarily an ozone season (i.e., summer) concern. Thus if you are modeling summer HC emissions, the July ASTM class for the area of interest should be used. Further information on determining the appropriate ASTM volatility class for use in MOBILE4 is provided in Appendix 2B.

2.2.11 MINIMUM and MAXIMUM DAILY TEMPERATURE

2.2.11.1 Description

The minimum and maximum daily temperatures are used in MOBILE4 in the calculation of the diurnal portion of evaporative HC emissions. The temperatures used in calculating the temperature corrections to exhaust HC, CO, and NOx emissions, the hot soak portion of evaporative emissions, and the running loss HC emissions will be calculated by MOBILE4 based on the minimum and maximum temperatures input here if TEMFLG = 1, and is not the same as the input ambient temperature (section 2.3.4).

2.2.11.2 Options

The user must input values for the minimum and maximum ambient temperatures. The minimum temperature must be between 0°F and 100°F (-18° to 38°C), and the maximum temperature must be between 10°F and 120°F (-12° to 49°C) inclusive. The maximum temperature must be greater than or equal to the minimum temperature.

2.2.11.3 Use in MOBILE4

MOBILE4 uses the temperature limits of the evaporative portion of the Federal Test Procedure (FTP) [minimum 60°F (16°C), maximum 84°F (29°C)] to estimate basic diurnal emission rates. Diurnal emissions in MOBILE4 are adjusted for the minimum and maximum temperatures provided as input through the use of the uncontrolled diurnal index (UDI)*, which expresses diurnal emissions for a given range of temperature as a multiple of FTP diurnal emission rates. This is done whether TEMFLG = 1 or 2.

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* For further discussion of the UDI and its use in estimating the diurnal portion of evaporative emissions, see "Draft Regulatory Impact Analysis for Control of Gasoline Volatility and Evaporative Hydrocarbon Emissions from New Motor Vehicles," U.S. EPA, OAR, OMS, July 1987; pp. 2-54 to 2-71.

The basic exhaust emission rates for HC, CO, and NOx are based on temperature of 75°F. MOBILE4 calculates an average temperature for each pollutant, representing average emissions over the course of the day, based on the input minimum and maximum daily temperatures, and adjusts the exhaust emission factors for temperature effects accordingly, if TEMFLG = 1. Hot soak emissions at FTP conditions are based on a temperature of 82°F (28°C). MOBILE4 calculates a temperature for the hot soak emissions based on the minimum and maximum temperatures input here if TEMFLG = 1, and adjusts the basic hot soak emission rates for temperature effects accordingly. Running loss HC emissions are also dependent on temperature. As for exhaust and hot soak emissions, MOBILE4 calculates an appropriate average temperature for use in correcting running loss emissions, weighted to account for differing emission levels at different temperatures in the range of the minimum and maximum daily temperatures, if TEMFLG = 1.

If TEMFLG = 2, the user-supplied input value of ambient temperature (see section 2.3.4) is used to determine temperature corrections for exhaust HC, CO, and NOx emissions, hot soak evaporative emissions, and running loss emissions. The use of TEMFLG = 2 is not recommended unless the modeling of a very short time period , such as an hour, is being performed. For modeling of entire days, TEMFLG = 1 is recommended, and will provide more accurate temperature corrections to the emission factors.

2.2.11.4 Required Information

Minimum and maximum daily temperatures (°F).

2.2.11.5 Guidance

The temperatures to be used here depend on the intended application of the results. Restrictions on these temperatures are: the maximum temperature must be greater than or equal to the minimum temperature, and the ambient temperature (used to adjust exhaust, hot soak, and running loss emission factors if TEMFLG = 1, and input as part of the Scenario section) should be between the minimum and maximum.

If the input daily maximum temperature or the calculated hot soak or running loss temperature is ≤ 40°F, or if the input daily minimum temperature is ≤ 25°F, evaporative emissions (including running loss emissions) are not calculated. EPA does not have sufficient data to estimate evaporative emissions at low temperatures, and there is reason to believe that such emissions approach zero when temperatures are sufficiently low. The MOBILE4 output will include a comment message noting that evaporative emission factors are not calculated if any of these conditions occur.

The model used in MOBILE4 to calculate diurnal emissions may not be accurate when very large diurnal temperature ranges are used. Thus, if the diurnal temperature range (daily maximum minus daily minimum) is > 40 F°, a warning message is printed noting that the diurnal evaporative emission factor has been calculated but may be inaccurate.

Crankcase emissions are always included in the evaporative emission factors. If evaporative emissions are not calculated for any of the reasons noted above, crankcase emissions are still calculated and output (as the only contributor to evaporative emissions), since these emissions are dependent on engine operating temperatures rather than ambient temperatures.

Finally, if the calculated exhaust emission correction temperature is ≤ 40°F, exhaust emission factors are not corrected for the effects of fuel volatility (RVP), for similar reasons.

2.2.12 BASE RVP

2.2.12.1 Description

Evaporative (and to a lesser extent exhaust) emissions vary with fuel volatility. EPA's new vehicle certification program and much of its emission factor testing use gasoline with a volatility (RVP) of 9.0 psi. However, in recent years much of the country has been supplied with gasoline of higher (in some cases, considerably higher) volatility. MOBILE4 adjusts the emission factors to account for the effects of fuel volatility.

The value to be used for base RVP is the in-use average RVP of gasoline in the area to be modeled that prevails in the base year, and is expected to prevail up to the in-use volatility control start year. (The major function of base and in-use RVP values in MOBILE4 is to allow the user to define a step change in fuel volatility at a specific calendar year; see section 2.2.13.)

2.2.12.2 Options

The value used for base RVP can be anywhere between 7.0 psi and 15.2 psi inclusive. However, for accurate and meaningful results, the guidance provided below should be followed.

2.2.12.3 Use in MOBILE4

The base RVP is used in MOBILE4, for calendar years of evaluation prior to the in-use start year, to account for the effects of fuel volatility on emissions. Thus, the use of the appropriate value of RVP allows the construction of more accurate emission factors and a more accurate base inventory. If the calendar year of evaluation is after the specified in-use start year, then the base RVP input value is ignored (in the sense that it will not have an impact on the emission factors for the evaluation year).

2.2.12.4 Required Information

A value of RVP (in psi) representing the current prevailing average fuel volatility for the geographic area of interest, in the absence of any requirements for volatility control.

2.2.12.5 Guidance

As with the temperature inputs discussed above, the intended use of the MOBILE4 run determines the season for which in-use RVP should be determined. For ozone-related (summer season) modeling, use the summer (July) RVP. Alternatively, if modeling of emission factors is being performed on a month-by-month basis, the value of base RVP appropriate to each of the specific months being modeled should be used.

The impact of fuel volatility on emissions is much lower at colder temperatures. (In MOBILE4, no correction to exhaust emissions to account for the effects of RVP is applied if the calculated (TEMFLG = 1) or input (TEMFLG = 2) temperature applicable to exhaust emissions is ≤40°F.) For CO modeling, the base RVP for the season of interest (which will depend on when and at what temperatures most CO violations occurred) should be used. Again, if modeling is being performed on a month-by-month basis, values of RVP appropriate to each month for which emission factors are being modeled should be used. Further guidance on the determination of the appropriate value to use as input for base RVP is provided in Appendix 2B.

2.2.13 IN-USE RVP and IN-USE START YEAR

2.2.13.1 Description

EPA has proposed that summer fuel RVP be limited to 9.0 psi in ASTM Class C areas, with corresponding proportional reductions in summer fuel RVP for ASTM Class A and B areas.* MOBILE4 provides the ability to model the effects of an RVP control program through specification of the in-use RVP limit and the year in which the requirement is effective.

2.2.13.2 Options

The user must input values for the in-use RVP and in-use start year. The value of in-use RVP can be between 7.0 and 15.2 psi inclusive. If you wish to include in the modeling the effects of an in-use fuel volatility control program, then appropriate values for in-use RVP and in-use start year should be provided. The earliest allowed in-use start year is 1989. Thus the effects of local (state, regional) fuel volatility control programs, which may be more stringent and/or take effect sooner than Federal controls, can be modeled. It is also possible to assume no in-use volatility control program (see section 2.2.13.4).

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* Federal Register, Vol. 52 No. 160, August 19, 1987; pp. 31274.

2.2.13.3 Required Information

The control RVP level to be assumed (psi) and the calendar year in which the control program is first effective.

To model the effects of the Federal volatility control program proposed by EPA, in which volatility would be limited in the summer months (May through September) in ASTM Class C areas with proportional limits required in ASTM Class A and B areas, contact EPA's Office of Mobile Sources (Standards Development and Support Branch, 313/668-4423 or FTS 374-8423) to determine the appropriate input values.

2.2.13.4 Guidance

If no fuel volatility control program is to be assumed, then the value of base RVP should be used as the value of in-use RVP as well. In this case, with no change in RVP, the start year of RVP control should be set to CY 2020 (IUSESY = 20). To model the effect of a summer fuel volatility control program, you should use the proposed summer RVP limit as the value of in-use RVP, and the year in which the program is projected to take effect as the value of in-use start year.

This concludes the One-time data section.

2.3 SCENARIO SECTION

The Scenario data follow the One-time data in the MOBILE4 input stream, and are used to assign values to those variables that specifically define each of the scenarios to be evaluated. It consists of one to four records, depending on the values set in the Control section.

The user can calculate emissions for one or more scenarios. Each scenario is associated with one group of Scenario section records. The program terminates execution upon detecting an end-of-file condition.

The first record, consisting of those variables discussed in sections 2.3.1 through 2.3.5, must be included for every scenario of every MOBILE4 run. The second possible record, required only if LOCFLG = 1, consists of local area parameters to be applied for this scenario only (see sections 2.1.13, 2.2.8 through 2.2.13). The third possible record, required only if VMFLAG = 3, consists of the VMT mix to be applied for this scenario only (see sections 2.1.6, 2.2.2). The fourth possible record, required only if ALHFLG = 2 or 3, consists of either six or ten additional input values used to correct certain exhaust emission factors (see sections 2.1.10 and 2.3.8).

Table 2.3-1 summarizes the Scenario section input record(s), including the variable names, codes, and allowable values for each field.

2.3.1 REGION

2.3.1.1 Description

The first specification required in the first record of the Scenario data section is the region for which emission factors are to be calculated.

2.3.1.2 Options

MOBILE4 provides two options for region: low-altitude and high-altitude. Low-altitude emission factors are based on conditions representative of approximately 500 feet above mean sea level (+500 ft MSL), and high-altitude factors are based on conditions representative of approximately +5500 ft MSL. MOBILE4, like MOBILE3, does not calculate California emission factors.

2.3.1.3 Use in MOBILE4

The region selected determines whether the MOBILE4 emission factor calculations will be based on low-altitude or high-altitude basic emission rates.

2.3.1.4 Required Information

You must enter a value of either 1 (low-altitude) or 2 (high-altitude) for the region.

2.3.1.5 Guidance

For the majority of MOBILE4 applications, low-altitude is the appropriate choice. For those areas designated as high- altitude by EPA for mobile source regulatory purposes, generally those counties that lie "substantially" above +4000 ft MSL, high-altitude should be selected. A list of those counties EPA has designated as high-altitude appears in §86.088-30, paragraphs (a)(5) (ii) and (iv), Code of Federal Regulations.

2.3.2 CALENDAR YEAR

2.3.2.1 Description

The value used for calendar year in MOBILE4 defines the year for which emission factors are to be calculated (as of January 1).

2.3.2.2 Options

MOBILE4 has the ability to model emission factors for the years 1960 through 2020 inclusive.

2.3.2.3 Required Information

You must enter a value for the last 2 digits of the calendar year of evaluation (range 60-99 and 00-20).

2.3.3 SPEED

2.3.3.1 Description

Emission factors vary considerably with the average speed assumed. The value(s) input for speed in MOBILE4 will have a significant impact on the resulting emission factors. In general, HC and CO emissions are at a minimum at the average speed of the Federal Test Procedure (FTP) used for new vehicle certification, or 19.6 mph, with emissions increasing as average speeds move further from that value (either higher or lower). NOx emissions are generally higher than FTP rates at speeds under 19.6 mph, and slightly lower than FTP rates at speeds greater than 19.6 mph.

2.3.3.2 Options

You have the option of using one average speed for all vehicles (SPDFLG = 1) or of using eight average speeds, one for each vehicle type (SPDFLG = 2). MOBILE4 will calculate emission factors for average speeds of 2.5 to 55.0 mph, in increments of 0.1 mph. If a speed below 2.5 mph is input, a warning message will be issued by MOBILE4 and 2.5 mph will be used in the calculations. Note that the minimum speed of 2.5 mph represents a reduction from the 5.0 mph minimum speed that could be used in MOBILE3.

Similarly, if a speed above 55 mph is input, a warning message will be issued and 55.0 mph will be used in the calculations. Although the speed limit has been increased to 65 mph on certain portions of limited access highway in some states, EPA does not have data adequate for the characterization of emissions at higher speeds and does not believe that the extrapolation of the speed correction factor equations to such speeds should be considered reliable. Further, areas with a legal speed limit of 65 mph are generally rural (outside of urban areas with populations of 50,000 or more). Thus, 55.0 mph continues to be the maximum speed for which MOBILE4 will calculate emission factors.

2.3.3.3 Use of Average Speed in MOBILE4

The data base on which all emission factor calculations are based is developed from vehicle test results at based on FTP conditions, including the average speed of 19.6 mph. MOBILE4 adjusts the emission factors for speeds other than 19.6 mph (20 mph for HDGVs and HDDVs) through the use of speed correction factors.

2.3.3.4 Required Information

You must supply either a single value which is assumed to apply to all vehicles (if SPDFLG = 1), or eight values (one for each regulated vehicle class) in the following order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC (if SPDFLG = 2).

2.3.3.5 Guidance

The FTP driving cycle is intended to be representative of driving conditions typical of a standard commute in an urban area. Thus the use of 19.6 mph as the average speed applicable to all vehicle types is appropriate for many modeling situations intended to represent traffic in urban areas as a whole. The average speed of the transient test cycle used for heavy-duty engine certification is 20 mph, which is representative of urban driving overall but not of commuting trips. Use of 19.6 mph as the average speed for all vehicles therefore will lead to a small speed correction being applied to HDGV and HDDV emission factors.

For some applications of MOBILE4, you might assume a single value other than 19.6 mph. For example, to model emission factors typical of a stretch of limited access highway, the use of 55 mph for all vehicle types would be appropriate.

The prediction of average speeds in the future is difficult, and may be a critical factor in some areas' ability to project compliance with SIP commitments and air quality standards. EPA may provide additional guidance in the final SIP calls for control strategies and attainment demonstrations.

If you need to run MOBILE4 using speed(s) representative of certain areas (e.g., subsets of urban areas, specific highway links) or of certain times of day, there are often speed data available from local, regional, or state transportation planning agencies. A discussion of how average speeds can be estimated from available data sources is presented in "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," (revised), EPA-450/4-81-026d.

2.3.4 AMBIENT TEMPERATURE

2.3.4.1 Description

Refer also to sections 1.1.4, 2.1.14, and 2.2.11.

Emissions vary considerably with ambient temperature. The value of temperature used to apply the temperature correction factors for exhaust emissions, hot soak evaporative emissions, and running loss emissions will have a significant impact on the resulting emission factors.

If TEMFLG = 1, the temperature used to adjust the exhaust emission factors for all three pollutants, the hot soak component of evaporative emissions, and running loss emission factors will be calculated by MOBILE4 on the basis of the input minimum and maximum daily temperatures. The ambient temperature specified here will not be used.

If TEMFLG = 2, the value of ambient temperature specified here will be used as the basis of the temperature correction factors for all exhaust emissions, hot soak evaporative emissions, and running loss emissions. The input values for minimum and maximum daily temperatures will still be used in calculating the diurnal component of evaporative emissions. The use of TEMFLG = 2 causes the input value of ambient temperature to be used to correct the exhaust emission factors in the same way as in MOBILE3. If the specified ambient temperature is inconsistent with the minimum and maximum daily temperatures (e.g., 20°F ambient with 60°-84°F minimum and maximum), an error message will result and processing of the current scenario will be aborted.

2.3.4.2 Options

The ambient temperature specified can range from 0°F (-18°C) to 110°F (43°C). If a temperature less than 0°F is input, a warning message will be issued, and 0°F will be used in the calculations if TEMFLG = 2. Similarly, if a temperature greater than 110°F is input, a warning is issued, and 110°F is used in the calculations if TEMFLG = 2.

2.3.4.3 Use of Ambient Temperature in MOBILE4

The basic emission rates that underlie the emission factor calculations are developed from emission data from vehicles tested at FTP conditions, with an ambient temperature of 75°F (24°C). MOBILE4 uses temperature correction factors to correct exhaust emission factors to temperatures other than 75°F. If TEMFLG = 2, the value input here for ambient temperature is used to make these corrections.

2.3.4.4 Required Information

A value of ambient temperature in degrees Fahrenheit (°F).

2.3.4.5 Guidance

As with many of the other input parameters, the value used for AMBT depends in large part on the purpose for which MOBILE4 is being run. Some suggestions are offered below. Additional information and guidance on the determination of the appropriate ambient temperature is provided in Appendix 2C.

The ambient temperature logically must be between the minimum and maximum temperatures. This is particularly important when HC emission factors are being modeled, since minimum and maximum temperatures are used in the evaporative emission component of those calculations (section 2.2.11), and the evaporative and exhaust components of the emission factor should be estimated on a consistent basis. Modeling of CO emission factors is more likely to focus on times with cooler temperatures, when most violations of the National Ambient Air Quality Standard (NAAQS) for CO occur.

2.3.5 OPERATING MODES (PCCN, PCHC, PCCC)

2.3.5.1 Description

One important determinant of emissions performance is the mode of operation. EPA's emission factors are based on testing over the FTP cycle, which is divided into three segments (referred to as "bags"), each with differing associated emissions performance. The bags correspond to operating modes:

Bag	Operating Mode
1	Cold start
2	Stabilized
3	Hot start

Emission data from each of these bags reflect the fact that emissions generally are highest when a vehicle is in cold-start mode: the vehicle, engine, and emission control equipment (particularly the catalytic converter) are all at ambient temperature and thus not performing at optimum levels. Emissions are generally somewhat lower in hot start mode, when the vehicle is not yet completely warmed up but was not sitting idle for sufficient time to have cooled completely to ambient temperatures. Finally, emissions generally are lowest when the vehicle is operating in stabilized mode, and has been in continuous operation long enough for all systems to have attained relatively stable, fully "warmed-up" operating temperatures.

The three variables PCCN, PCHC, PCCC are sufficient to completely define the percent VMT accumulated in each of the three operating modes by vehicles in each of two basic emission control configurations, non-catalyst and catalyst-equipped. Thus the input of values for percent VMT accumulated in hot start mode by non-catalyst vehicles, or in stabilized mode by non-catalyst or catalyst-equipped vehicles, is not required as input. MOBILE4 calculates these quantities from the three values entered.

The definitions of the three variables and how together they define six vehicle type/operating mode combinations are shown below:

Vehicle Type	Operating Mode	Defined in MOBILE4 as:
Non-catalyst	Cold-start	PCCN
Catalyst	Hot-start	PCHC
Catalyst	Cold-start	PCCC
Catalyst	Stabilized	1.0 - PCCC - PCHC
Non-catalyst	Stabilized	1.0 - PCCC - PCHC (assumed equal to the stabilized VMT fraction for catalyst-equipped vehicles)
Non-catalyst	Hot-start	PCCC - PCCN + PCHC

The user should not expect the sum of PCCN + PCHC + PCCC to be 100 percent. While it is true that (percent VMT in cold-start mode) + (percent VMT in hot-start mode) + (percent VMT in hot stabilized mode) always equals 100 percent, for both catalyst-equipped and non-catalyst vehicles separately, the variables PCCN, PCHC, and PCCC are not equivalent to these variables.

The values of PCHC, PCCC, and PCCN are used in the calculation of the bag-dependent correction factors (such as temperature and volatility) for LDV, LDT, and MC emission factors. It is assumed that all diesel vehicles and all motorcycles are always non-catalyst.

EPA historically has defined cold starts to be any start that occurs at least four hours after the end of the preceding trip for non-catalyst vehicles and at least one hour after the end of the preceding trip for catalyst-equipped vehicles. Hot starts are those starts that occur less than four hours after the end of the preceding trip for non-catalyst vehicles and less than one hour after the end of the preceding trip for catalyst- equipped vehicles. The shorter time interval associated with the cold/hot start definition for catalyst-equipped vehicles reflects the fact that catalytic converters do not operate at intended efficiency until they are fully warmed up (to operating temperatures in the 600°F (316°C) range); thus catalyst-equipped vehicles reflect "cold-start" emissions performance after a much shorter off time than do non-catalyst vehicles, which do not depend on attainment of such high temperatures for stabilization of emissions performance.

2.3.5.2 Options

The three specified values must all be expressed as percentages (not fractions). The sum of PCHC + PCCC must be less than 100 percent (if PCCC + PCHC = 100%, for example, the implicit statement is that catalyst-equipped vehicles accumulate no VMT in stabilized mode). The value of PCCN logically should be less than that of PCCC, for the reasons discussed above.

2.3.5.3 MOBILE4 Standard (FTP) Operating Mode Fractions

The values of the three variables corresponding to the conditions of the FTP cycle are:

PCCN	20.6 %
PCHC	27.3 %
PCCC	20.6 %

These values reflect the same assumptions and conditions that are reflected in other aspects of the Federal Test Procedure.

2.3.5.4 Required Information

Three percentage values, reflecting the percentage of **VMT** (**not** the percentage of vehicles) accumulated by non-catalyst vehicles in cold-start mode (PCCN), by catalyst-equipped vehicles in hot-start mode (PCHC), and by catalyst-equipped vehicles in cold-start mode (PCCC).

2.3.5.5 Guidance

In the absence of supporting data for values other than those listed above, EPA believes that the values reflecting FTP conditions are appropriate in many cases. This is particularly true when the emission factors being modeled are intended to represent a broad geographic area (Metropolitan Statistical Area, entire state) and/or a wide time period (days, months). When the modeling is intended to represent highly localized conditions (specific highway links) or very limited periods of time (as single hours), it may be possible to develop more representative values for these variables. Areas known to have average trip lengths significantly shorter or longer than 7.5 miles may also merit the use of alternate values.

Thus for SIP-related modeling, EPA will accept the use of the FTP operating mode values except for small scale scenarios where their use would clearly be inappropriate. EPA will not accept SIP-related modeling that includes different operating mode fractions for the base and projection years without adequate quantitative written justification.

There are several ways of approximating the percentage of VMT accumulated in each mode for each type of vehicle, although highly accurate determinations are not readily obtainable. Guidance on three possible methods for determining the cold- start/hot-start VMT fractions for non-catalyst and catalyst- equipped vehicles, including references to generally available data sources, appears in Chapter 8 of the report "Techniques for Estimating MOBILE2 Variables."

2.3.6 LOCAL AREA PARAMETER RECORD

The local area parameter (LAP) record was discussed in sections 2.2.8 through 2.2.13, and is summarized in Table 2.2-5. It must appear in the Scenario data section if a different LAP record is to be applied to each scenario (LOCFLG = 1), and must appear in the One-time data section if the same LAP record is to be applied for all scenarios (LOCFLG = 2). The information provided in sections 2.2.8 through 2.2.13 is applicable in either case. This record must be supplied, in either the One-time data section or the Scenario data section, for every MOBILE4 run.

2.3.7 VEHICLE MILES TRAVELLED MIX by vehicle type

The VMT mix was discussed in section 2.2.2. This record must appear in the Scenario data section if different VMT mixes are to be applied to each scenario (VMFLAG = 2), and must appear in the One-time data section if the same VMT mix is to be applied to all scenarios (VMFLAG = 3). The information provided in section 2.2.2 is applicable in either case. This record is not required if the MOBILE4 VMT mix is to be used (VMFLAG = 1).

2.3.8 Additional Correction Factors for Light-Duty Gasoline-Fueled Vehicle Types

2.3.8.1 General Description

MOBILE4 provides the capability of applying four additional correction factors to the exhaust emission factors for LDGVs, LDGT1s, and LDGT2s. These factors are used to represent unique conditions not typically assumed in MOBILE4 runs, which is why they are segregated from other correction factors (such as speed and temperature).

These factors allow for exhaust emission factors only to be adjusted to account for the emissions impact of air conditioning (A/C) usage, extra loading, and trailer towing. There is also a humidity correction factor, which applies only to exhaust NOx emissions and is also applied to motorcycles.

2.3.8.2 Options

Depending on the value assigned to the ALHFLG flag controlling the application of these additional correction factors, six or ten input values may be required.

When ALHFLG = 2, six values are required:

1) One A/C usage fraction (for all LDGVs and LDGTs)
2-4) Three extra load usage fractions (one each for LDGVs, LDGT1s, and LDGT2s)
5) One trailer towing fraction (for all LDGVs and LDGTs)
6) One humidity level (for all LDGVs and LDGTs plus motorcycles)

When ALHFLG = 3, ten values are required:

1) One A/C usage fraction (for all LDGVs and LDGTs)
2-4) Three extra load usage fractions (one each for LDGVs, LDGT1s, and LDGT2s)
5-7) Three trailer towing fractions (one each for LDGVs, LDGT1s, and LDGT2s)
8) One humidity level (for all LDGVs and LDGTs plus motorcycles)
9-10) Dry bulb and wet bulb temperatures (used to calculate an A/C usage fraction for LDGVs and LDGTs).

Each of these five types of input (A/C, extra load, trailer towing, humidity, and temperature) are discussed below.

2.3.8.3 A/C Usage Fraction (AC)

2.3.8.3.1 Description

If you wish to include the effect on the exhaust emission factors of A/C usage, enter a value representing the fraction of A/C-equipped vehicles assumed to actually be operating with their air conditioners running.

2.3.8.3.2 Options

This fractional value must be between zero and one ($0.0 \leq AC \leq 1.0$). If the value entered is zero, no correction will be applied (i.e., the correction factor will be 1.0).

In the six value option (ALHFLG = 2), the value of AC input here will be used to determine the correction factor.

In the ten value option (ALHFLG = 3), the A/C usage fraction will be calculated on the basis of the dry bulb and wet bulb temperatures (see section 2.3.8.7). In this case any value can be entered for AC, subject to the constraint that $0.0 \leq AC \leq 1.0$, but it will be ignored by MOBILE4 in favor of the calculated usage fraction.

2.3.8.4 Extra Load Usage Fractions [XLOAD(3)]

2.3.8.4.1 Description

These values are used to model the exhaust emissions impact of vehicles carrying an extra 500 lb (227 kg) load. If you wish to include this effect, three fractional values are entered (one each for LDGVs, LDGT1s, and LDGT2s), representing the fraction of all vehicles of the given type carrying such an extra load.

2.3.8.4.2 Options

These values must all lie between zero and one ($0.0 \leq XLOAD(i) \leq 1.0$). If the value entered is zero, no correction for the effects of extra load is applied.

2.3.8.5 Trailer Towing Usage Fraction [TRAILR or TRAILR(3)]

2.3.8.5.1 Description

These values are used to model the impact on exhaust emissions of vehicles towing trailers. If you wish to include this effect in your modeling, one or three fractions are entered representing the fraction of vehicles of a given type that are to be assumed to be towing trailers.

2.3.8.5.2 Options

Any value for this fraction must lie between zero and one ($0.0 \leq TRAILR(i) \leq 1.0$). If the value entered is zero, no correction for the effect of trailer towing is applied.

In the six value option (ALHFLG = 2), one value is entered and is applied to LDGVs, LDGT1s, and LDGT2s.

In the ten value option (ALHFLG = 3), three values are entered, and one each is applied to LDGVs, LDGT1s, and LDGT2s.

2.3.8.6 NOx Humidity Correction (ABSHUM)

2.3.8.6.1 Description

This value is used to correct exhaust NOx emission factors for absolute humidity. The value entered is the absolute (specific) humidity, expressed as grains of water per pound of dry air.

2.3.8.6.2 Options

The value entered for absolute humidity must lie between 20 and 140 ($20. \leq ABSHUM \leq 140.$). If the value entered is 75, corresponding to the absolute humidity condition of the FTP, then no correction will be applied.

2.3.8.7 Dry and Wet Bulb Temperatures (DB, WB)

2.3.8.7.1 Description and Use in MOBILE4

MOBILE4 will calculate the fraction of A/C-equipped vehicles actually using their air conditioning on the basis of a "discomfort index," which in turn is calculated from the dry bulb and wet bulb temperatures.

2.3.8.7.2 Options and Guidance

The values of each of these temperatures must be between 0° and 110°F (-18° and 43°C), inclusive. In addition, the wet bulb temperature must be less than or equal to the dry bulb temperature. If any of these three conditions are not met, an error message will be issued by MOBILE4.

These values (in °F) will be used to calculate the A/C usage fraction on the basis of the discomfort index only if the ten value option is selected (ALHFLG = 3). If used, this calculated value will override any value read in for AC as part of the input.

2.3.8.8 Guidance

The use of these additional correction factors is rarely necessary for most users of MOBILE4. It should be noted that the data underlying these correction factors was developed for MOBILE2, and have not been updated since that time. (For example, the air conditioning correction factor is based in part on the fraction of vehicles that are equipped with air conditioning; this fraction is substantially higher for the vehicle fleet of the late 1980s than it was for the fleet of the late 1970s, a fact which is not reflected in MOBILE4).

If you believe that conditions applying to a specific application of MOBILE4 warrant the use of one or more of the correction factors described in this section, and desire guidance beyond that provided above, contact EPA for additional information (Test and Evaluation Branch, 313/668-4325 or FTS 374-8325).

2.4 SUMMARY OF MOBILE4 INPUT SEQUENCE

Table 2.4-1 summarizes the input sequence required for a MOBILE4 run, in the order required by the program. Records listed in parentheses are optional, and are only required if certain flags have been assigned specific values in the Control section.

2.5 OBTAINING REFERENCED DOCUMENTS

Two of the reports specifically mentioned in the guidance subsections of this document, "Techniques for Estimating MOBILE2 Variables" and "Additional Techniques for Estimating MOBILE2 Variables," can be obtained through the National Technical Information Service (NTIS). These reports were prepared by Energy and Environmental Analyses, Inc., for EPA under contract (Contract No. 68-03-2888). The NTIS number is:

Report Title	NTIS Number
"Techniques for Estimating MOBILE2 Variables" and "Additional Techniques for Estimating MOBILE2 Variables" (both reports come as one order)	PB 83 183277

For price information and to order, contact

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Attention: Sales

Phone: (703) 487-4650

The User's Guides to the earlier emission factor models, MOBILE2 and MOBILE3, are also available thorough NTIS at at the above address for those who might wish to obtain them:

Title: User's Guide to MOBILE2
NTIS Ref: PB 81 205619
Estimated costs: Paper - $34.95
(as of 1/1/89) Microfiche - $ 5.95

Title: User's Guide to MOBILE3
NTIS Ref: PB 84 213974
Estimated costs: Paper - $34.00
(as of 1/1/89) Microfiche - $ 5.95

The report referenced in section 1.0, "Guidance on Estimating Motor Vehicle Emission Reductions From the Use of Alternative Fuels and Fuel Blends," is also available through NTIS:

Title: Guidance on Estimating Motor Vehicle Emission Reductions From the Use of Alternative Fuels and Fuel Blends
NTIS Ref: PB 88 169594/AS
Estimated cost: Paper - $14.95
(as of 1/1/89)

The report "Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources," (revised), EPA-450/4-81-026d, December 1988, should be available to State and local air quality planning officials by contacting their respective EPA Regional Offices.

Table 2.1-1

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4

Record Number	Variable Name	Content and Codes	Format	Refer to Section
1	**PROMPT**	Flag for prompting of remaining Control section data 1 = No prompting, vertical format 2 = Prompting, vertical format 3 = No prompting, horizontal format 4 = Prompting, horizontal format	I1,3A1	2.1.1
	IOUNEW	Values for output units: (1) Formatted reports unit (2) Diagnostic messages unit (3) Prompting messages unit (Allowable values for each unit are 1, 2, 3, 6, 7, or 8. The default value for all three output units is 6.)		2.1.2
2	**PROJID**	80 characters for title	20A4	2.1.3
3	**TAMFLG**	Flag for optional input of tampering rates. 1 = Use MOBILE4 rates 2 = Input alternate rates[1]	I1	2.1.4
4	**SPDFLG**	Selects speeds for each vehicle type. 1 = One speed for all vehicle types[2] 2 = Eight speeds, one for each vehicle type[2]	I1	2.1.5

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4

Record Number	Variable Name	Content and Codes	Format	Refer to Section
5	**VMFLAG**	Selects optional use of user-supplied VMT mix among vehicle types. 1 = Use MOBILE4 VMT mix 2 = Input one VMT mix for each scenario[2] 3 = Input one VMT mix for all scenarios[1]	I1	2.1.6
6	**MYMRFG**	Flag for optional input of annual mileage accumulation rates and/or registration distributions by age. 1 = Use MOBILE4 values 2 = Input annual mileage accumulation rates[1] 3 = Input registration distributions by age[1] 4 = Input both annual mileage accumulation rates and registration distributions[1]	I1	2.1.7
7	**NEWFLG**	Flag for optional input of modifications to basic exhaust emission rates (BERs). 1 = Use MOBILE4 BERs 2 = Input one or more alternate BERS[1]	I1	2.1.8
8	**IMFLAG**	Flag to include impact of operating I/M program in emission factor calculations. 1 = No I/M program assumed 2 = I/M program assumed[1]	I1	2.1.9

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4

Record Number	Variable Name	Content and Codes	Format	Refer to Section
9	**ALHFLG**	Flag to correct exhaust emission factors (gasoline-fueled vehicles only) for: a) air conditioning usage b) extra vehicle load c) trailer towing d) humidity (NOx only). 1 = No corrections 2 = Input six values[2] 3 = Input ten values[2]	I1	2.1.10
10	**ATPFLG**	Flag to include impact of of anti-tampering program (ATP) on emission rates. 1 = No ATP assumed 2 = ATP assumed[1]	I1	2.1.11
11	**RLFLAG**	Flag for control of whether and how refueling emission factors are calculated. 1 = Uncontrolled rates 2 = Stage II VRS assumed[1] 3 = Onboard VRS assumed[1] 4 = Stage II and onboard VRS assumed[1] 5 = No refueling emission factors calculated	I1	2.1.12
12	**LOCFLG**	Flag for control of user input of local area parameter (LAP) record. 1 = One LAP record input for each scenario[2] 2 = One LAP record input for all scenarios[1]	I1	2.1.13

Table 2.1-1 (continued)

FLAGS CONTROLLING INPUT TO AND EXECUTION OF MOBILE4

Record Number	Variable Name	Content and Codes	Format	Refer to Section
13	**TEMFLG**	Flag for control of values of temperature to be used for correcting emission factors for effects of temperature 1 = MOBILE4 calculates temperatures to be used in correction of emission factors, from input values of minimum and maximum ambient daily temperature; value read as input for ambient temperature is overridden by calculated values. 2 = Use to input value of ambient temperature to correct emission factors for temperature effects	I1	2.1.14

[1] Record(s) must appear in One-time data section.
[2] Record(s) must appear in Scenario data section.

Table 2.1-2

FLAGS CONTROLLING OUTPUT OF MOBILE4

Record Number	Variable Name	Content and Codes	Format	Refer to Section
14	**OUTFMT**	Selects the structure of formatted output report. 1 = 221-column numerical 2 = 140-column numerical 3 = 112-column descriptive 4 = 80-column descriptive	I1	2.1.15
15	**PRTFLG**	Selects pollutants for which emission factors are to be calculated and included in output. 1 = HC only 2 = CO only 3 = NOx only 4 = All three pollutants	I1	2.1.16
16	**IDLFLG**	Controls calculation and output of idle emission factors. 1 = No idle EFs 2 = Include idle EFs	I1	2.1.17
17	**NMHFLG**	Selects total or non-methane HC emission factor calculations and output. 1 = Total HC EFs 2 = Non-methane HC EFs	I1	2.1.18
18	**HCFLAG**	Controls printing of only total HC or all component HC emission factors in output. 1 = No component EFs printed 2 = Total and component EFs printed	I1	2.1.19

Table 2.2-1

SUMMARY OF ALTERNATE BER RECORDS
(required in the One-time Data section if NEWFLG = 2)

Record	Field	Content, Variable Name, and Codes	Format	Allowable Values
1	1	Number of BER records to follow (**NEWCT**)	I3,/	1 to 100
2 thru N+1	1	Code for region new BER applies to: (**NEWREG**) 1 = low-altitude 2 = high-altitude	I1,1X	1 or 2
	2	Code for vehicle type new BER applies to: (**NEWVEH**) 1 = LDGV 5 = LDDV 2 = LDGT1 6 = LDDT 3 = LDGT2 7 = HDDV 4 = HDGV 8 = MC	I1,1X	1 to 8
	3	Code for pollutant new BER applies to: (**NEWPOL**) 1 = HC 2 = CO 3 = NOx	I1,1X	1 to 3
	4	First model year new BER applies to (last 2 digits) (**NEWMYF**)	I2,1X	60-99, 00-20
	5	Last model year new BER applies to (last 2 digits) (**NEWMYL**)	I2,1X	60-99, 00-20
	6	New ZML (**ZMLNEW**)	F6.2,1X	≥ 0.0
	7	New DR (or DR1*) (**DRNEW**)	F6.2,1X	≥ 0.0
	8	New DR2* (**A5ONEW**)	F6.2,/	≥ 0.0

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* DR2 only for 1981 and later model year LDGVs (section 2.2.4.4). Field 8 is blank otherwise, and the DR appears in Field 7.

Table 2.2-2

SUMMARY OF I/M PROGRAM DESCRIPTIVE INPUT RECORD
(required in the One-time Data section if IMFLAG = 2)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1	Program start year (**ICYIM**) (last 2 digits of first calendar year of program operation)	I2,1X	60-99, 00-20	2A.1.2
2	Stringency level (**ISTRIN**) (percent)	I2,1X	10 to 50	2A.1.3
3	First model year (**MODYR1**) (last 2 digits of oldest model year of vehicles included in program)	I2,1X	41-99, 00-20	2A.1.4
4	Last model year (**MODYR2**) (last 2 digits of latest model year of vehicles included in program)	I2,1X	41-99, 00-20	2A.1.5
5	Waiver rate for pre-1981 model year vehicles (**WAIVER(1)**) (percent)	F2.0,1X	0 to 50	2A.1.6
6	Waiver rate for 1981 and later model year vehicles (**WAIVER(2)**) (percent)	F2.0,1X	0 to 50	2A.1.6
7	Compliance rate (**CRIM**) (percent)	F3.0,1X	0 to 100	2A.1.7
8	Program type (**INTYP**)	I1,1X	1 to 3	
	1 = Centralized			2A.1.12
	2 = Decentralized/Computerized			2A.1.13
	3 = Decentralized/Manual			2A.1.14

Table 2.2-2 (continued)

SUMMARY OF I/M PROGRAM DESCRIPTIVE INPUT RECORD
(required in the One-time Data section if IMFLAG = 2)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
9	Inspection frequency (**IFREQ**) 1 = annual 2 = biennial	I1,1X	1 or 2	2A.1.8
10	Vehicle types subject to inspections (**ILDT(4)**) ILDT(1) --> LDGV ILDT(2) --> LDGT1 ILDT(3) --> LDGT2 ILDT(4) --> HDGV 1 = not subject to inspection 2 = subject to inspection	4I1,1X	1 or 2 (in each column)	2A.1.9
11	Test type (**ITEST**) 1 = Idle test 2 = 2500/Idle test 3 = Loaded Idle test	I1,1X	1 or 2	2A.1.10
12	Flag to indicate whether alternate I/M credits are to be input by user (**NUDATA(2)**) NUDATA(1) --> For Tech I-II NUDATA(2) --> For Tech IV+ 1 = Use MOBILE4 I/M credits 2 = Read in alternate I/M credits on logical I/O device unit 4	2I1	1 or 2	2A.1.11 2A.1.15

Table 2.2-3

SUMMARY OF ATP DESCRIPTIVE INPUT RECORD
(required in the One-time Data section if ATPFLG = 2)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1	Program start year (**LAPSY**) (last 2 digits of first calendar year of ATP operation)	I2,1X	60-99, 00-20	2A.1.2
2	First model year (**LAP1ST**) (last 2 digits of oldest model year of vehicles included in ATP)	I2,1X	41-99, 00-20	2A.1.4
3	Last model year (**LAPLST**) (last 2 digits of latest model year of vehicles included in ATP)	I2,1X	41-99 or 00-20	2A.1.5
4	Vehicle types subject to inspections (**LVTFLG(4)**) Enter 1 or 2 for each vehicle type, in this order: LVTFLG(1) --> LDGV LVTFLG(2) --> LDGT1 LVTFLG(3) --> LDGT2 LVTFLG(3) --> HDGV 1 = not subject to ATP inspection 2 = subject to ATP inspection	4I1,1X	1 or 2 (in each column)	2A.1.9
5	Program type (**ATPPGM**) 1 = Centralized 2 = Decentralized	I1	1 or 2	 2A.1.12 2A.1.13

Table 2.2-3 (continued)

SUMMARY OF ATP DESCRIPTIVE INPUT RECORD
(required in the One-time Data section if ATPFLG = 2)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
6	Inspection frequency (**ATPFQT**) 1 = annual 2 = biennial	I1,1X	1 or 2	2A.1.8
7	Compliance rate (**CRATP**) (percent)	F4.0,1X	0 to 100	2A.1.7
8	Inspections performed (**DISTYP(8)**) Enter 1 or 2 for each inspection type, in this order:	8I1	1 or 2 (in each column)	
	DISTYP(1) --> Air pump system			2A.2.3
	DISTYP(2) --> Catalyst			2A.2.4
	DISTYP(3) --> Fuel inlet restrictor			2A.2.5
	DISTYP(4) --> Tailpipe lead deposit test			2A.2.6
	DISTYP(5) --> EGR system			2A.2.7
	DISTYP(6) --> Evaporative control system			2A.2.8
	DISTYP(7) --> PCV system			2A.2.9
	DISTYP(8) --> Gas cap			2A.2.10
	1 = Inspection not performed 2 = Inspection performed			

Table 2.2-4

SUMMARY OF STAGE II AND ONBOARD VRS DESCRIPTIVE INPUT RECORDS
(required in the One-time Data section if RLFLAG = 2, 3, or 4)

Stage II VRS Input Record (required if RLFLAG = 2 or 4)

Field	Content, Variable Name, Codes	Format	Allowable Values
1	Stage II start year (**IS2SY**) (last 2 digits of calendar year in which Stage II requirement is first effective)	I2,1X	89-99, 00-20
2	Phase-in period (**NPHASE**) (number of years allowed for all stations subject to Stage II requirement to complete installation)	I1	1 to 9
3	Percent efficiency of Stage II VRS at controlling refueling emissions from LDGVs and LDGTs (**PCTEL**)	1X,I3	0 to 100
4	Percent efficiency of Stage II VRS at controlling refueling emissions from HDGVs (**PCTEH**)	1X,I3	0 to 100

Onboard VRS Input Record (required if RLFLAG = 3 or 4)

Field	Content, Variable Name, Codes	Format	Allowable Values
1	Onboard start year (**IOBMY**) (last 2 digits of first model year vehicles are subject to onboard VRS requirement)	I2,1X	89-99, 00-20
2	Vehicle types covered (**IVOB(4)**) Enter 1 or 2 for each vehicle type, in this order: IVOB(1) --> LDGV IVOB(3) --> LDGT2 IVOB(2) --> LDGT1 IVOB(4) --> HDGV 1 = No 2 = Yes	4I1	1 or 2 (in each column)

Table 2.2-5

SUMMARY OF THE LOCAL AREA PARAMETER RECORD
(required in the One-time Data section if LOCFLG = 2,
and required in the Scenario Data section if LOCFLG = 1)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1	Scenario name (**SCNAME**)	4A4,1X	N/A	2.2.9
2	ASTM volatility class (**ASTMCL**)	A1	A,B,C,D,E	2.2.10
3	Minimum daily temperature (**TEMMIN**), in °F	F5.0	0.-100.	2.2.11
4	Maximum daily temperature (**TEMMAX**), in °F	F5.0	0.-120.	2.2.11
	(TEMMIN and TEMMAX are used in the diurnal index calculations for evaporative HC emissions. If TEMFLG = 1, they are also used in the calculation of temperatures for correction of exhaust HC, CO, and NOx emissions, hot soak evaporative emissions, and running loss emissions.)			
5	Base RVP (**RVPBAS**), in psi (Current average fuel volatility for the geographic area of interest)	F5.1	7.0-15.2	2.2.12
6	In-use RVP (**IUSRVP**), in psi (Regulated fuel volatility limit after implementation of in-use volatility control in the geographic area of interest)	F5.1,1X	7.0-15.2	2.2.13
7	In-use start year (**IUSESY**) (Last 2 digits of first calendar year of in-use fuel volatility control)	I2	89-99, 00-20	2.2.13

Table 2.3-1

SUMMARY OF THE SCENARIO RECORD(S)

Record 1: Scenario Descriptive Record (MANDATORY)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1	Region for which emission factors are to be calculated (**IREJN**) 1 = low-altitude 2 = high-altitude	I1,1X	1 or 2	2.3.1
2	Calendar year of evaluation (**CY**) (Last 2 digits of calendar year for which emission factors are to be calculated, as of January 1)	I2	60-99, 00-20	2.3.2
3	Average speed to be used in emission factor calculations (**SPD** or **SPD(8)**)		2.5-55.0	
	If SPDFLG = 1, one speed is used for all vehicle types	1X,F4.1		2.3.3
		-or-		
	If SPDFLG = 2, eight speeds are used, as follows: SPD(1) --> LDGV SPD(2) --> LDGT1 SPD(3) --> LDGT2 SPD(4) --> HDGV SPD(5) --> LDDV SPD(6) --> LDDT SPD(7) --> HDDV SPD(8) --> MC	8(F4.1,1X)		2.3.3

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

Record 1: Scenario Descriptive Record (MANDATORY) (continued)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
4	Ambient temperature (**AMBT**), in °F (If TEMFLG = 2, ambient temperature is used to correct exhaust, hot soak evaporative, and running loss emission factors for temperatures other than 75°F)	1X,F4.1	0.0-110.0	2.3.4
5	Operating mode fractions (**PCCN**, **PCHC**, **PCCC**), in % (Percent of VMT accumulated by: PCCN --> Non-catalyst vehicles in cold-start mode PCHC --> Catalyst-equipped vehicles in hot-start mode PCCC --> Catalyst-equipped vehicles in cold-start mode)	3(1X,F4.1)	0.0-100.0	2.3.5

NOTE: Values **MUST** be entered for all fields in the scenario descriptive record. There are **NO DEFAULT VALUES** for these variables.

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

Record 2: LAP record for this scenario only
(OPTIONAL) (required only if LOCFLG = 1)

See Table 2.2-5

Record 3: VMT mix by vehicle type record
(OPTIONAL) (required only if VMFLAG = 2)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1-8	VMT fraction accumulated by each of eight vehicle types (**VMTMIX(8)**) VMTMIX(1) --> LDGV VMTMIX(2) --> LDGT1 VMTMIX(3) --> LDGT2 VMTMIX(4) --> HDGV VMTMIX(5) --> LDDV VMTMIX(6) --> LDDT VMTMIX(7) --> HDDV VMTMIX(8) --> MC	8F4.3	0.0-1.0	2.2.2 and 2.3.6

Record 4: Additional Correction Factor record
(OPTIONAL) (required only if ALHFLG = 2 or 3)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
1	Air conditioning usage fraction (**AC**) (Percent of all A/C-equipped vehicles assumed to actually be using their A/C)	F4.2	0.0-1.0	2.3.8.3

Note: If ALHFLG = 2, input value of AC is used to calculate correction factor.

If ALHFLG = 3, input value is overridden by calculated value (see 2.3.8.7); however, a value must be entered here.

Table 2.3-1 (continued)

SUMMARY OF THE SCENARIO RECORD(S)

Record 4: Additional Correction Factor record (continued)
(OPTIONAL) (required only if ALHFLG = 2 or 3)

Field	Content, Variable Name, Codes	Format	Allowable Values	Refer to Section
2-4	Extra load fraction (**XLOAD(3)**) (Percent of vehicles assumed to be carrying additional 500 lbs) XLOAD(1) --> LDGV XLOAD(2) --> LDGT1 XLOAD(3) --> LDGT2	3F4.2	0.0-1.0	2.3.8.4
5 or 5-7	Trailer towing fraction (**TRAILR** or **TRAILR(3)**) (Percent of vehicles assumed to be towing trailers)	F4.2 or 3F4.2	0.0-1.0	2.3.8.5
Note:	If ALHFLG = 2, one value is required and is used to calculate correction factor for all three vehicle types. If ALHFLG = 3, three values are required and are used to calculate correction factors as follows: TRAILR(1) -> LDGV TRAILR(2) -> LDGT1 TRAILR(3) -> LDGT2			
6 or 8	Absolute humidity level (**ABSHUM**) (Humidity in grains water per pound dry air, used to correct exhaust NOx emission factors)	F4.0	20.-140.	2.3.8.6
9, 10	Dry bulb and wet bulb temperatures (**DB**,**WB**), in °F If ALHFLG = 3 only, these temperatures are used to calculate a "discomfort index," which in turn is used to estimate an A/C usage fraction (which then overrides the value input for AC in Field 1 of this record).	2F4.0	0.-110.	2.3.8.7

Table 2.4-1

SUMMARY OF THE MOBILE4 INPUT RECORD SEQUENCE

Input Record Sequence	Input Section	Refer to Section
1 PROMPT flag record	CONTROL	2.1.1
(1-3 IOUNEW values)*	CONTROL	2.1.2
1 PROJID record	CONTROL	2.1.3
1 TAMFLG flag record[1]	CONTROL	2.1.4
1 SPDFLG flag record[1]	CONTROL	2.1.5
1 VMFLAG flag record[1]	CONTROL	2.1.6
1 MYMRFG flag record[1]	CONTROL	2.1.7
1 NEWFLG flag record[1]	CONTROL	2.1.8
1 IMFLAG flag record[1]	CONTROL	2.1.9
1 ALHFLG flag record[1]	CONTROL	2.1.10
1 ATPFLG flag record[1]	CONTROL	2.1.11
1 RLFLAG flag record[1]	CONTROL	2.1.12
1 LOCFLG flag record[1]	CONTROL	2.1.13
1 TEMFLG flag record[1]	CONTROL	2.1.14
1 OUTFMT flag record[1]	CONTROL	2.1.15
1 PRTFLG flag record[1]	CONTROL	2.1.16
1 IDLFLG flag record[1]	CONTROL	2.1.17
1 NMHFLG flag record[1]	CONTROL	2.1.18
1 HCFLAG flag record[1]	CONTROL	2.1.19
(20 or 40 tampering records)[2] if TAMFLG = 2	ONE-TIME	2.2.1
(1 VMT mix record) if VMFLAG = 3	ONE-TIME	2.2.2
(16 mileage accumulation rate records) if MYMRFG = 2 or 4	ONE-TIME	2.2.3
(16 registration distribution records) if MYMRFG = 3 or 4	ONE-TIME	2.2.3
(1 to 100 basic emission rate records) if NEWFLG = 2	ONE-TIME	2.2.4
(1 I/M program descriptive record) if IMFLAG = 2	ONE-TIME	2.2.5
(1 ATP descriptive record) if ATPFLG = 2	ONE-TIME	2.2.6
(1 or 2 refueling emission VRS descriptive records)[3] if RLFLAG = 2, 3, or 4	ONE-TIME	2.2.7
(1 LAP record) if LOCFLG = 2	ONE-TIME	2.2.8
1 Scenario descriptive record	SCENARIO	2.3.1
(1 LAP record) if LOCFLG = 1	SCENARIO	2.2.8
(1 VMT mix record) if VMFLAG = 2	SCENARIO	2.2.2
(1 additional correction factor record) if ALHFLG = 2 or 3	SCENARIO	2.3.8

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* Required only if reassignment of output device numbers is desired.

[1] These 16 flags are entered on one record (format 16I1) if PROMPT = 3 or 4.

[2] 20 records if IMFLAG = 1; 40 records if IMFLAG = 2.

[3] Stage II record if RLFLAG = 2; onboard record if RLFLAG = 3; both records if RLFLAG = 4.

Appendix 2A

INSPECTION/MAINTENANCE AND ANTI-TAMPERING PROGRAM TERMINOLOGY DEFINITIONS

This appendix discusses the terminology used to describe inspection and maintenance (I/M) and anti-tampering (ATP) programs for purposes of modeling the emission benefits of such programs using MOBILE4. In general, it is assumed that the I/M program is mandatory, periodic, and covers a well defined group of vehicles. There are many details (such as instrument specifications) which are beyond the scope of this listing. Program planners should consult with EPA (Technical Support Staff, 313/668-4367 or FTS 374-8367) if there is any question as to what is required of I/M programs.

2A.1 I/M PROGRAM TERMINOLOGY

2A.1.1 I/M

I/M refers to "inspection and maintenance" programs which are inspections of vehicles using a measurement of tailpipe emissions and which require that all vehicles with tailpipe emissions higher than the program cutpoints be repaired to pass a tailpipe emission retest. (For convenience, such tailpipe I/M programs and anti-tampering programs are sometimes referred to collectively as simply "I/M programs" in other EPA documents.)

2A.1.2 Start Year

The year in which the periodic inspection program begins to require both inspection and repairs is called the start year. MOBILE4 only allows for a January 1st start date. Other start dates will require interpolation between two MOBILE4 runs to give accurate estimates of benefits.

2A.1.3 Stringency

Stringency is the tailpipe emission test failure rate among pre-1981 model year passenger cars or pre-1984 light-duty trucks expected in an I/M program based on its short test emission cutpoints. The expected failure rate can be determined by applying the program cutpoints to a representative sample of vehicles tested in a survey. Failure rates reported by the program would not be used to determine stringency if there is the possibility of significant testing or data reporting errors. MOBILE4 assumes that the failure rate remains fixed at the stringency level for each evaluation year. MOBILE4 will not allow a stringency less than 10% or greater than 50%.

2A.1.4 First Model Year

The first model year refers to the oldest model year vehicle which is always included in the inspection program. MOBILE4 assumes that all vehicle classes have the same model year coverage and does not allow for a separate coverage for each vehicle class. Some programs do not fix the model years covered by the program, and instead use a coverage "window" to define which vehicles must be inspected. For example, such a program may cover only vehicles 15 years old or younger. Such programs cannot be modeled accurately using MOBILE4 without special assistance.

2A.1.5 Last Model Year

The last model year refers to the youngest (newest) model year vehicle which is always subject to the inspection program. This allows for a program to cover only particular model years. Most programs routinely include the new model year vehicles in the program as they reach one year old. It is recommended that the maximum allowable last model year (2020) be input as the last model year, unless a special case requires some other input. MOBILE4 I/M credits already assume that vehicles less than one year old are exempt from inspection, so that input of the maximum last model year allows for maximum flexibility.

2A.1.6 Waivers

Many I/M programs waive the requirement to pass a retest if certain defined criteria are met. MOBILE3 normally assumed that all vehicles of the model years and vehicle classes indicated by the user input complied with the program cutpoints. Waivers are often granted in I/M programs, however, for vehicles whose owners have spent over a set dollar limit in attempting to comply with the program retest requirement.

The waiver rate input in MOBILE4 reduces the estimated benefit of the I/M program design. The waiver rate is always calculated as a percent of non-duplicate initial test failures. MOBILE4 assumes that tampered or misfueled vehicles cannot receive waivers, and does not reduce the ATP benefit based on the waiver rate.

2A.1.7 Compliance Rate

Compliance rate refers to the level of compliance with the inspection program. For example, assume a program required that all passenger cars be inspected each year, and that there were 100,000 passenger cars registered in the area covered by the program. If, in a given year, only 95,000 passenger cars completed the inspection process to the point of receiving a final certificate of compliance or waiver, it could be assumed that the remaining 5,000 vehicles were avoiding the program inspection requirement. The compliance rate for this program would then be 95%. The number of initial inspections should not be used to calculate the compliance rate since some cars may drop out after failing one or more tests. The compliance rate input is also used to account for vehicles which are waived from compliance without any testing (e.g., vehicles with special testing problems or vehicles owned by certain types of owners).

MOBILE4 uses a single compliance rate to reduce both the I/M and ATP portions of the program benefits. The reduction in benefit is not linear. The benefit loss per vehicle assumes that the failure rate among non-complying vehicles will be larger than the expected failure rate in the fleet. As the rate of non-compliance increases, the non-complying failure rate will approach and finally equal the expected failure rate.

The following table shows the loss of benefit assumed for the enforcement fraction:

Compliance Rate	Non-Compliance Rate	Non-Complier Failure Rate Adjustment	Fraction Benefit Loss	Fraction Benefit Remaining
100%	0%	2.0	.000	1.000
99%	1%	2.0	.020	.980
98%	2%	2.0	.040	.960
97%	3%	2.0	.060	.940
96%	4%	2.0	.080	.920
95%	5%	1.5	.095	.905
90%	10%	1.4	.169	.831
85%	15%	1.3	.238	.762
80%	20%	1.2	.302	.698
75%	25%	1.1	.361	.639
70%	30%	1.0	.415	.585
50%	50%	1.0	.615	.385

2A.1.8 Inspection Frequency

MOBILE4 allows for two inspection frequencies. Annual means that all covered vehicles must be inspected once each year. Biennial means that each vehicle is inspected once every two years, such that half of each model year is inspected each year. Any other inspection frequency would require alternate I/M credits provided by EPA.

2A.1.9 Vehicle Classes

MOBILE4 program benefits are calculated separately for each gasoline-fueled vehicle class. No emission benefit is estimated for diesel fueled vehicles or motorcycles. The vehicle class designations are based on the certification standards definitions. The classes are:

- LDGV - light-duty gasoline-fueled vehicles which are passenger vehicles.
- LDGT1 - light-duty gasoline-fueled trucks less than 6,000 lbs gross vehicle weight. These are the lighter pick-up trucks and vans.
- LDGT2 - light-duty gasoline-fueled trucks greater than 6,000 lbs gross vehicle weight, but less than 8,500 lbs. These are the heavier pick-up trucks and vans and many commercial trucks.
- HDGV - heavy-duty gasoline-fueled vehicles greater than 8,500 lbs gross vehicle weight. These are the heavier commercial trucks, including highway hauling trucks.

Many areas do not use the same vehicle class designations in their vehicle registration data as are used in MOBILE4. In these cases care must be taken not to claim coverage for too many vehicles.

2A.1.10 I/M Test Types

There are three I/M test types normally allowed in MOBILE4. These test types only apply to the inspection of 1981 and newer model year passenger cars and 1984 and newer light-duty trucks. The concept of stringency already takes into account the effect of the test type on the benefits from older vehicles. The chosen test type is assumed to be applied to all 1981 and newer passenger cars and 1984 and newer light-duty trucks both at the initial inspection and the retest.

- **Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle as it idles in neutral or park.

- **2500/Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle at 2500 rpm in neutral or park and again at idle. The vehicle must pass both at idle and at 2500 rpm in order to pass the test.

- **Loaded/Idle Test** refers to a measurement of HC and CO emission concentrations of a fully warmed vehicle at 30 ± 1 mph on a chassis dynamometer at a constant load and again at idle in neutral or park. The vehicle must pass both at idle and at load in order to pass the test.

2A.1.11 Alternate I/M Credits

In special cases where the design of the I/M program to be modeled does not fit into any of the categories defined in MOBILE4, the model allows the user to supply a set of factors that will be used to determine the I/M program benefits. Normally these factors will be supplied by EPA at the request of the program manager or air quality planner.

2A.1.12 Centralized

Centralized inspection programs refer to those programs which completely separate the inspection of vehicles from the repairs. Usually a few high-volume inspection stations, run either by the local agency itself or by a contractor, will perform all initial tests and retests after repair. Garages and other repair facilities are not allowed to perform official tests. Centralized programs are the standard used to determine the emission benefits for I/M and ATP program designs.

2A.1.13 Decentralized

Decentralized inspection programs refer to those programs where the local program agency licenses stations to perform official inspections and reinspections. These licensed inspection stations are allowed to perform repairs on the vehicles they inspect. The number of licensed inspections stations in decentralized programs is larger and the volume per station is smaller than for centralized programs.

Decentralized programs have been found to be less effective than centralized designs. As a result, MOBILE4 will reduce the emission benefits from a centralized design by 50% for the I/M portion and 50% for the ATP portion of the program if a decentralized design is chosen.

2A.1.14 Computerized Inspection

Some decentralized I/M programs require the use of "computerized" emission analyzers. These analyzers contain small computers which keep track of all official inspection activity, automatically calibrate the instrumentation and prompt the inspector during the inspection procedure. The computer also prepares a machine-readable record of all official inspections and calibrations and will not allow inspections whenever it determines the instrumentation to be out of calibration.

Computerized analyzers improve the performance of the I/M portion of a decentralized inspection program. MOBILE4 assumes that the I/M portion of a decentralized computerized inspection program will be as effective as a centralized program of similar stringency. Decentralized computerized inspection programs will still have the benefits from the ATP portion of the program reduced by 50%.

2A.1.15 Tech I-II and Tech IV+

The calculation of I/M benefits for MOBILE4 was done by "technology group," which can roughly be determined by model year for each vehicle type. These technology groups have come to be referred to by numbers. The table below summarizes the technology groupings used in MOBILE4 and their respective application to gasoline-fueled passenger cars and light trucks.

Technology Grouping	Model Years Covered		
	LDGV	LDGT1	LDGT2
I	Pre-1975	Pre-1975	Pre-1979
II	1975-80	1975-83	1979-83
IV+	1981+	1984+	1984+

Sets of alternate I/M credits may contain both Tech I and II credits, only Tech IV+ credits, or Tech I, II, and IV+ credits together. This is usually indicated in the header block of the alternate I/M credit deck.

2A.2 ATP TERMINOLOGY

This section discusses the terminology used to describe ATP inspections for purposes of modeling the emission benefits of such programs using MOBILE4. In general, it is assumed that the program is mandatory, periodic, and covers a well defined group of vehicles. A program which inspects for tampering only when a vehicle has failed its tailpipe I/M inspection, or only when a vehicle owner requests a test waiver, is not considered to have an ATP in MOBILE4.

It is also assumed that the inspections are primarily visual rather than functional, and involve no disassembly or disconnections to gain access to hidden components (other than removal of the gas cap to view the fuel inlet restrictor). However, program planners are encouraged to define failure in broad enough terms of visual damage and proper operating condition so that any emission control component determined by the inspector to be non-functional can be properly failed and repaired. There are many details (such as replacement catalyst specifications) which are beyond the scope of this listing. Program planners should consult with EPA's Office of Mobile Sources (Technical Support Staff, 313/668-4367 or FTS 374-8467) if there is any question as to what is required of ATP inspections.

2A.2.1 ATP

ATPs are "anti-tampering programs," which are periodic inspections of vehicles to detect damage to, disablement of, or removal of emission control components. Owners are required to restore the vehicle's emission control system and have the vehicle reinspected. Note that programs that inspect for tampering only those vehicles failing an I/M tailpipe test are not considered for MOBILE4 modeling purposes to have an ATP, and should not attempt to derive ATP emission reduction credits.

2A.2.2 Tampering and Misfueling

Any physical damage to, or disablement or removal of, an emission control component is considered tampering in MOBILE4. This does not limit tampering only to deliberate disablements or only to those disablements of which the vehicle owner is aware. As a result, tampering can often be a result of poor maintenance as opposed to some action by the vehicle owner or a service mechanic. Misfueling is the use of leaded fuel in any vehicle which is equipped with a catalytic converter. This includes inadvertent use of leaded fuel without the knowledge of the vehicle owner.

2A.2.3 Air Pump Inspection

Air pump systems supply fresh air needed by the catalytic converter to reduce engine emissions before they leave the tailpipe. Inspectors should check for missing belts and hoses and proper connection at the exhaust manifold. Sometimes the entire pump and its plumbing are removed. A valve is sometimes used to route air away from the exhaust stream during certain operating modes. This valve should be checked for proper hose and wire connections. Often the air is injected directly into the catalytic converter underneath the vehicle. If so, this connection should be checked. Any missing, damaged or altered components of the air pump system should be replaced.

2A.2.4 Catalyst Inspection

The catalytic converter, sometimes referred to simply as the catalyst, oxidizes excess hydrocarbon and carbon monoxide from the engine exhaust into water and carbon dioxide. Newer catalysts also reduce oxides of nitrogen in the exhaust. The metals which accomplish this task are most commonly coated on a ceramic honeycomb inside the stainless steel shell of the catalyst. The catalyst resembles a muffler in some ways, but would not be confused with a muffler because it is farther forward on the vehicle, and its stainless steel shell will not rust.

Some cars will have more than one catalyst, so the number of catalysts expected should be determined before the inspection begins. Some catalysts are located very near the exhaust manifold, so the inspector should be sure to check the entire length of the exhaust piping from the exhaust manifold to the muffler before determining that the catalyst is not present.

Emission credit should not be claimed in MOBILE4 unless regulations provide a mechanism to assure that failed cars are correctly repaired with OEM or approved aftermarket replacements. Program planners should consult with EPA to avoid incorrectly claiming credit.

2A.2.5 Fuel Inlet Restrictor Inspection

Vehicles requiring the use of only unleaded gasoline have been equipped with fuel inlets that only allow use of narrow fuel nozzles. Leaded fuel is required to be dispensed only from pumps using wider nozzles. Any vehicle found to have a fuel inlet which allows a leaded fuel nozzle to be inserted, such as having the nozzle size restriction removed, is assumed to have used leaded fuel. Leaded fuel permanently reduces the ability of the catalytic converter to reduce emissions. Therefore, vehicles found with a fuel inlet which allows insertion of a leaded fuel nozzle should be required to replace the catalytic converter. In addition, the vehicle's fuel inlet should be repaired to only allow the insertion of unleaded fuel nozzles.

Repair of the fuel inlet restrictor only is not considered a repair which will reduce the emissions of the vehicle. The damage to the emission control of the vehicle occurs in the catalyst. It is the catalyst which must be replaced to result in any substantial emission reduction. The inlet restrictor must be replaced simply as protection for the new catalyst.

The model assumes that inspectors are not allowed to skip this inspection for such reasons as that the fuel inlet is concealed by a locked door.

2A.2.6 Tailpipe Lead Detection Test

Leaded fuel permanently reduces the ability of the catalytic converter to reduce engine emissions before they leave the tailpipe. Therefore, vehicles found to have used leaded fuel should be required to replace the catalytic converter. EPA has allowed for the use of a lead detection test in the vehicle tailpipe as a method to detect the use of leaded fuel. Since this is a chemical test, care must be taken to assure that the test is properly conducted and that the results are properly interpreted.

Vehicles with evidence of lead deposits in the tailpipe have used leaded fuel. The damage to the emission control of the vehicle occurs in the catalyst. It is the catalyst which must be replaced to result in any substantial emission reduction. (The tailpipe should also be replaced simply to avoid failing the test at the next inspection.) ATPs which require failure of both the fuel inlet restrictor inspection and the tailpipe lead detection test before requiring replacement of the catalyst get credit for neither in MOBILE4, and should not indicate either inspection on the input records.

2A.2.7 EGR Inspection

The exhaust gas recirculation (EGR) system reduces oxides of nitrogen by routing some of the exhaust back into the intake manifold. The primary component of the system is the valve which controls the flow between the exhaust and intake manifolds, however, most systems are quite complex with various sensors and valves which control the operation of the system. Hoses may be plugged, either deliberately or by neglect. Any system observed with missing or damaged components or misrouted or plugged hoses and wires should be failed and repaired.

2A.2.8 Evaporative Control System

The evaporative control system collects gasoline vapors from the gas tank and carburetor bowl and stores them in a charcoal canister. During certain engine operations, the canister purges, releasing the vapors which are routed to the engine to be burned. In addition to the evaporative canister itself, the system includes varying numbers of hoses, wires and control valves. Hoses may be plugged, either deliberately or by neglect. Any system observed with missing or damaged components or misrouted or plugged hoses and wires should be failed and repaired.

2A.2.9 PCV Inspection

The positive crankcase ventilation (PCV) system routes the vapors from the crankcase to the intake manifold where they can be burned by the engine. The PCV system has two major loops. The most critical connects the crankcase with the throttle or the intake manifold with a hose and usually contains a valve. Another hose connects the crankcase with the air cleaner to provide the crankcase with filtered fresh air. Any system observed with damaged or missing components or with hoses misrouted or plugged, should be failed and repaired.

2A.2.10 Gas Cap Inspection

Gas caps are actually part of the evaporative control system. Without a properly operating gas cap, fuel vapors from the gas tank would escape. On some vehicles, a missing gas cap will also cause the evaporative system canister to purge incorrectly. Inspectors should examine the fuel inlet area of each vehicle to determine that the gas cap is present. If not, the vehicle should be failed and the gas cap replaced. Inspectors should not be allowed to skip this inspection for such reasons as that the fuel inlet is concealed by a locked door.

Appendix 2B

RVP AND ASTM CLASS DETERMINATION GUIDANCE

This appendix describes how to determine the average in-use volatility (as measured by Reid vapor pressure, or RVP) for gasoline in a given city, metropolitan statistical area (MSA), or state in a way that is consistent with other MOBILE4 inputs and is acceptable to EPA for use in preparing State Implementation Plans and similar analyses. It also describes how to determine the ASTM Class for a given city or state for MOBILE4 modeling purposes.

2B.1 RVP GUIDANCE

2B.1.1 Determine the period from which the relevant design value (ozone or carbon monoxide) is calculated. This is normally a three-year period, and currently encompasses the years 1984, 1985, and 1986.

2B.1.2 The most recent of the three years included in the relevant design value calculation is the year for which RVP is to be determined as described below.

2B.1.3 The easiest method of determining the value of RVP to use in MOBILE4 is to use the American Society for Testing and Materials' (ASTM's) suggested limit, based on the month and year and the area for which RVP is to be determined. To determine the appropriate ASTM class for the area to be modeled, see section 2B.2. EPA will accept use of the value determined in this way for base RVP in MOBILE4 runs used by the States in their inventory development and other SIP-related mobile source modeling.

An area may also choose to determine base RVP for a given area through the use of gasoline survey data. EPA wil also accept the use of RVP determined in accordance with the guidance below from either of two regularly published gasoline volatility surveys, by the National Institute for Petroleum and Energy Research (NIPER) and the Motor Vehicle Manufacturers' Association (MVMA). Section 2B.1.5 is applicable if the NIPER survey is used, and section 2B.1.6 is applicable if the MVMA survey is used.

2B.1.4 Determination of RVP by ASTM class:

2B.1.4.1 Determine the ASTM volatility class for the area of interest, as outlined in section 2B.2.

2B.1.4.2 For HC (ozone) modeling, use the **July** ASTM class.

2B.1.4.3 For CO modeling, use the ASTM class for the month in which the current design value was recorded. See 2B.2.2 under "ASTM Class Guidance," below.

2B.1.4.4 Use the corresponding value of RVP as the base RVP **(RVPBAS)** in MOBILE4:

ASTM Class:	A	B	C	D	E
RVP limit:	9.0	10.5	11.5	13.5	15.0

2B.1.5 If the NIPER survey is used:

2B.1.5.1 Obtain the appropriate edition of the report "Motor Gasolines," published semi-annually (winter and summer surveys) by NIPER.

The cost per report is $35, and it is available from:

Cheryl L. Dickson
National Institute for Petroleum and Energy Research
P. O. Box 2128
Bartlesville, OK 74005

Phone (918) 336-2400

2B.1.5.1.1 For HC (ozone) modeling, the summer NIPER survey should be used.

2B.1.5.1.2 For CO modeling, the appropriate NIPER survey to use depends on the temperatures associated with exceedances of the National Ambient Air Quality Standard (NAAQS) for CO for the area being modeled. If that temperature is 50°F or higher, and/or the majority of exceedances of the CO NAAQS occurred during the "summer" months (May-Sept), the use of the summer NIPER survey is recommended. If that temperature is less than 50°F, and/or the majority of exceedances of the CO NAAQS occurred during the "winter" months (Oct-April), the use of the winter NIPER survey is recommended.

2B.1.5.2 From this report, determine the district(s) of interest. The NIPER survey divides the country into seventeen districts, which are described in a table and illustrated on a map of the U.S.

2B.1.5.3 If the RVP of a specific city or MSA is desired, use the district in which the city or MSA is located. If the RVP for an entire state is desired, and that state lies entirely within one district, use that district; if the state lies within two or more districts, average the values obtained in 2B.1.4.4 and 2B.1.4.5 for each of the districts.

2B.1.5.4 Find the average RVP values for the district(s) of interest from Table 4 of the NIPER survey. Table 4 presents the average RVP of three grades of gasoline for each district: regular unleaded, regular leaded, and premium unleaded.

The distinction between the "regular" and "premium" grades is based on the antiknock (octane) index of the fuel, defined as the sum of the Research octane and Motor octane numbers divided by two: (R+M)/2. In Table 4, the grades of gasoline are defined by:

Regular unleaded: $(R+M)/2 < 90.0$
Premium unleaded: $(R+M)/2 \geq 90.0$
Regular leaded: $(R+M)/2 \leq 93.0$

2B.1.5.5 Determine the average RVP of gasoline in a district by weighting these three values at 50 percent regular unleaded, 25 percent premium unleaded, and 25 percent regular leaded:

District average RVP =
0.50 * (district average RVP of regular unleaded) +
0.25 * (district average RVP of premium unleaded) +
0.25 * (district average RVP of regular leaded)

2B.1.5.6 The value determined in 2B.1.5.5 (or the average of the values obtained in 2B.1.5.5 if the area for which the average RVP is being determined encompasses two or more districts) is then used as the value of base RVP **(RVPBAS)** in MOBILE4.

2B.1.6 If the MVMA survey is used:

2B.1.6.1 Obtain the appropriate edition of the "MVMA National Gasoline Survey," published semi-annually (winter and summer seasons) by the Motor Vehicle Manufacturers' Association. Ordering and price information is available from:

Mr. James Steiger
Motor Vehicle Manufacturers' Association
300 New Center Building
Detroit, MI 48202

Phone (313) 872-4311

2B.1.6.1.1 For HC (ozone) modeling, the summer MVMA survey should be used.

2B.1.6.1.2 For CO modeling, the appropriate MVMA survey to use depends on the temperatures associated with exceedances of the National Ambient Air Quality Standard (NAAQS) for CO for the area being modeled. Determine the temperature in accordance with the guidance provided in Appendix 2C of this chapter. If that temperature is 50°F or higher, and/or the majority of exceedances of the CO NAAQS occurred during the "summer" months (May-Sept), the use of the summer MVMA survey is recommended. If that temperature is less than 50°F, and/or the majority of exceedances of the CO NAAQS occurred during the "winter" months (Oct-April), the use of the winter MVMA survey is recommended.

2B.1.6.2 Determine the city or cities of interest that are included in the MVMA survey:

2B.1.6.2.1 If the average RVP for a specific city (or MSA) is desired, and that city is included in the MVMA survey, use the values for that city.

2B.1.6.2.2 If the average RVP for a specific city (or MSA) is desired, and that city is not included in the MVMA survey, use the values for the city that is both closest to the city of interest and of the same ASTM volatility class. (Determination of ASTM volatility class is discussed below.)

2B.1.6.2.3 If the average RVP for an entire state is desired and a city within that state is included in the MVMA survey, use the values for that city. If the average RVP for an entire state is desired and two or more cities in that state are included in the MVMA survey, average the values determined in 2B.1.6.3 and 2B.1.6.4 for each of those cities. If no city within the state for which average RVP is desired is included in the MVMA survey, use the values for the major city that is both nearest to the state of interest **and** of the same ASTM volatility class.

2B.1.6.3 Find the average RVP value(s) for the city or cities selected in section 2B.1.5.2 from the summary tables that appear near the end of the MVMA survey. The average RVP for regular unleaded gasoline is provided for all cities; the average RVP for premium unleaded and/or regular leaded gasoline is also provided for many cities.

2B.1.6.4 Determine the average RVP value(s) for the area of interest from the average RVP values supplied for different grades of gasoline as follows:

2B.1.6.4.1 If only the average RVP for regular unleaded gasoline is provided, use that value.

2B.1.6.4.2 If the average RVP for regular unleaded and one of the other two grades (either premium unleaded or regular leaded) is provided, weight the values at 75 percent regular unleaded and 25 percent of the other grade for which the RVP is provided:

Average RVP =
0.75 * (average RVP of regular unleaded) +
0.25 * (average RVP of either regular leaded or premium unleaded)

2B.1.6.4.3 If the average RVP is provided for all three grades for the city of interest, weight the values at 50 percent regular unleaded, 25 percent regular leaded, and 25 percent premium unleaded:

Average RVP =
0.50 * (average RVP of regular unleaded) +
0.25 * (average RVP of premium unleaded) +
0.25 * (average RVP of regular leaded)

2B.1.6.5 The value determined in 2B.1.6.4 is then used as the value of base RVP (**RVPBAS**) in MOBILE4.

2B.2 ASTM CLASS GUIDANCE

ASTM defines five volatility classes (designated by the letters A thru E) and assigns one or two of these classes to each state, for each month of the year. This guidance describes how to determine the appropriate ASTM class for use as input to MOBILE4.

2B.2.1 The ASTM volatility classes are specified in ASTM standard D 439. The most recent edition of this standard was issued in 1986 (D 439-86). The standard appears in the 1987 Annual Book of ASTM Standards (Section 5: Petroleum Products, Lubricants, and Fossil Fuels; Volume 05.01: Petroleum Products and Lubricants (I): D 56 - D 1947). This is available in most large libraries, or may be obtained directly from:

American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

Phone: (215) 299-5400

2B.2.2 Table 2 in ASTM D 439 lists the volatility class for each month of the year, for each state or portion of state (see below). In those cases where more than one class is listed, select the class with the lower volatility limit (i.e., the letter closer to "A").

Example: Alabama is listed as "C/B" for July; "B" is the appropriate value to select for MOBILE4 use.

2B.2.2.1 For HC (ozone) modeling, use the **July** ASTM class.

2B.2.2.2 For CO modeling, use the ASTM class for the month in which the current CO design value was recorded. (For example, if the 1984-86 CO design value was recorded on August 29, 1986, use the August ASTM class.)

2B.2.3 For states divided into two or more regions in the ASTM standard, select the value for that portion of the state containing the majority of the population:

State	Portion of state to use
CA	N coast, S coast, interior
IL	N of 40° latitude
NV	S of 38° latitude
NM	N of 34° latitude
OR	W of 122° longitude
TX	E of 99° longitude
WA	W of 122° longitude

2B.2.4 If the ASTM class of a specific city in one of the states listed in 2B.2.3 is desired, select the value for that portion of the state in which that city lies.

2B.2.5. The letter determined in 2B.2.2, 2B.2.3, or 2B.2.4 above is then used as the value of ASTM class **(ASTMCL)** in MOBILE4.

(Note: If a value other than one of the five letters A, B, C, D, or E is input as the value for ASTM class, MOBILE4 will issue an error message and the run will not be executed.)

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Appendix 2C

MINIMUM, MAXIMUM, AMBIENT TEMPERATURE DETERMINATION GUIDANCE

This appendix provides suggested guidance on determination of appropriate temperature inputs for use in MOBILE4, for SIP-related ozone (HC) and CO modeling.

2C.1 Temperature Guidelines for Evaporative Hydrocarbon Emissions Calculations

2C.1.1 Determine the period from which the ozone design value is calculated. This is normally a three year period and currently encompasses the years 1984 - 1986.

2C.1.2 List the 10 highest daily one-hour ozone concentrations and the dates of those concentrations for that period.

2C.1.3 Order the Local Climatological Data Monthly Summary for those dates and the area being modeled. Both individual monthly and annual subscription reports are available from:

National Climatic Data Center
Federal Building
Asheville, NC 28801-2696

Telephone: 704-259-0682
FTS 672-0682

Individual monthly reports cost $1.00. Annual subscriptions cost $8.50 per year, plus $5.00 the first year to initiate the subscription. The National Climatic Data Center accepts Visa, MasterCard, American Express, and check or money order.

2C.1.4 For each of the 10 highest daily one-hour ozone concentrations and dates listed in 2C.1.2, transcribe the maximum and minimum temperatures occurring on those dates according to the Local Climatological Data Monthly Summary.

The maximum daily temperature is located in column 2 on page one of the Summary. The minimum daily temperature is located in column 3 on page one of the Summary.

2C.1.5 Calculate the average maximum temperature occurring on those 10 days. Use this average maximum temperature as the value of maximum daily temperature in the One-time Data section of MOBILE4 (see section 2.2.11).

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2C.1.6 Calculate the average minimum temperature occurring on those 10 days. Use this average minimum temperature as the value of minimum daily temperature in the One-time Data section of MOBILE4 (see section 2.2.11).

2C.1.7 Calculate the ambient temperature, used in the Scenario descriptive record of MOBILE4 (see section 2.3.4), as follows:

$$\text{Ambient Temperature} = [2/3] * [\text{Average Maximum Temperature} - \text{Average Minimum Temperature}] + [\text{Average Minimum Temperature}]$$

2C.2 Temperature Guidelines for Carbon Monoxide Emissions Calculations

2C.2.1 Determine the period from which the carbon monoxide design value is calculated. This is normally a three-year period and currently encompasses the years 1984 - 1986.

2C.2.2 List the 10 highest non-overlapping 8-hour carbon monoxide concentrations and the dates of those concentrations for that period.

2C.2.3 Order the Local Climatological Data Monthly Summary for those dates and the area being modeled (see section 2C.1.3.)

2C.2.4 For each of the 10 highest non-overlapping 8-hour carbon monoxide concentrations and dates listed in 2C.2.2, transcribe the hourly temperatures occurring on those dates according to the Local Climatological Data Monthly Summary.

The hourly temperatures are located on pages 2 and 3 of the Summary. Use the column labeled "Air °F". Observations are listed at 3-hour intervals. Use linear interpolation to fill in the missing hours.

2C.2.5 Calculate the average temperature during the 8-hour period that the carbon monoxide exceedence occurred. This is the exceedence temperature.

2C.2.6 Calculate the average exceedence temperature occurring on the 10 highest non-overlapping 8-hour carbon monoxide concentration dates listed in 2C.2.2. Use this average exceedence temperature as the value of ambient temperature used in the Scenario descriptive input record of MOBILE4 (see section 2.3.4).

2C.2.7 When modeling carbon monoxide emissions only, use this same temperature as the value of both minimum and maximum daily temperature (see section 2.2.11), and set the value of TEMFLG = 2 in the Control data section.

2C.3 LIST OF SUGGESTED LOCAL CLIMATOLOGICAL DATA STATIONS FOR DETERMINING TEMPERATURES FOR USE IN MOBILE4

Table 2C.3-1 lists suggested climatological data stations for use in determining appropriate temperatures in accordance with the guidance provided above, for selected non-attainment areas.

Tabled 2C.3-1

Suggested Local Climatological Data Stations for Use in Determining Temperatures, for Selected Ozone and Carbon Monoxide Non-Attainment Areas

AREA	LOCAL CLIMATOLOGICAL DATA STATION(S)
ALLENTOWN-BETHLEHEM PA	ALLENTOWN, PA
ATLANTA GA	ATLANTA, GA
ATLANTIC CITY NJ	Average of ATLANTIC CITY AP, ATLANTIC CITY STATE MARINA
BAKERSFIELD CA	BAKERSFIELD, CA
BALTIMORE MD	BALTIMORE, MD
BATON ROUGE LA	BATON ROUGE, LA
BEAUMONT-PORT ARTHUR TX	PORT ARTHUR, TX
Metro BOSTON MA	BOSTON, MA
CHARLOTTE-GASTONIA NC	CHARLOTTE, NC
Metro CHICAGO IL	CHICAGO O'HARE AP
Metro CINCINNATI OH	CINCINNATI, OH
Metro CLEVELAND OH	Average of (CLEVELAND OH, AKRON-CANTON OH)
DALLAS-FORT WORTH TX	DALLAS-FT WORTH, TX
DENVER-BOULDER CO	DENVER, CO
EL PASO TX	EL PASO, TX
FRESNO CA	FRESNO, CA
GREATER CONNECTICUT Metro Area	HARTFORD, CT
Metro HOUSTON TX	Average of HOUSTON TX, GALVESTON TX
HUNTINGTON-ASHLAND WV-KY-OH	HUNTINGTON, WV
INDIANAPOLIS IN	INDIANAPOLIS, IN
JACKSONVILLE FL	JACKSONVILLE, FL
KANSAS CITY MO	Average of KANSAS CITY INT'L AP, KANSAS CITY DOWNTOWN AP
LAKE CHARLES LA	LAKE CHARLES, LA
LEXINGTON-FRANKFORT KY	LEXINGTON, KY
LONGVIEW-MARSHALL TX	SHREVEPORT, LA
LOS ANGELES CA	Average of LOS ANGELES AP, LOS ANGELES CO, LONG BEACH
LOUISVILLE KY	LOUISVILLE, KY
MEMPHIS TN	MEMPHIS, TN
Metro MIAMI FL	MIAMI, FL
Metro MILWAUKEE WI	MILWAUKEE, WI
MODESTO CA	STOCKTON, CA
MUSKEGON MI	MUSKEGON, MI
NASHVILLE TN	NASHVILLE, TN
NEW BEDFORD MA	PROVIDENCE, RI
Metro NEW YORK CITY NY	Average of NEW YORK CENTRAL PARK, NY JOHN F. KENNEDY INT'L AP, NY LAGUARDIA FIELD, NEWARK NJ, BRIDGEPORT CT

Tabled 2C.3-1 (continued)

Suggested Local Climatological Data Stations for Use in Determining Temperatures, for Selected Ozone and Carbon Monoxide Non-Attainment Areas

AREA	LOCAL CLIMATOLOGICAL DATA STATION(S)
Metro PHILADELPHIA PA	Average of PHILADELPHIA PA, WILMINGTON DE
PHOENIX AZ	PHOENIX, AZ
PORTLAND ME	PORTLAND, ME
PORTLAND OR	PORTLAND, OR
PORTSMOUTH-DOVER NH	Average of PORTLAND ME, CONCORD NH
PROVIDENCE RI	PROVIDENCE, RI
SACRAMENTO CA	SACRAMENTO, CA
SALT LAKE CITY UT	SALT LAKE CITY, UT
SAN DIEGO CA	SAN DIEGO, CA
SAN FRANCISCO CA	Average of SAN FRANCISCO AP, SAN FRANCISCO CO
SANTA BARBARA CA	Average of SANTA BARBARA CA, SANTA MARIA CA
ST. LOUIS MO	ST. LOUIS, MO
STOCKTON CA	STOCKTON, CA
TAMPA-ST. PETERSBURG FL	TAMPA, FL
TULSA OK	TULSA, OK
VISALIA-TULARE CA	FRESNO, CA
WASHINGTON DC	WASHINGTON NATIONAL AP
WORCESTER MA	WORCESTER, MA
YUBA CITY CA	SACRAMENTO, CA

Chapter 3

MOBILE3 OUTPUTS

3.0 INTRODUCTION

MOBILE4 produces three types of output: prompting messages, diagnostic messages, and formatted reports.

Prompting messages are available from MOBILE4 if the user selects PROMPT = 2 or 4 (section 2.1.1). These messages prompt the user to provide MOBILE4 input data in the proper sequence. There are two prompting formats: vertical flag input (PROMPT = 2) and horizontal flag input (PROMPT = 4). Otherwise the prompting messages are identical in both cases. Prompting messages are discussed in section 3.1.

Diagnostic messages are used to caution the user concerning user-supplied data. Three types of diagnostics exist: errors, warnings, and comments. An error will in all cases terminate processing of the current scenario, and in some cases will terminate processing of the entire run. Warnings and comments are included to assist users in the interpretation of the results of MOBILE4. Diagnostic messages are discussed in section 3.2.

Four types of formatted reports can be produced by MOBILE4. These reports include the information necessary to identify the scenario being studied and the calculated emission factors by vehicle type. The type of formatted report produced is controlled by the value assigned to the OUTFMT flag in the Control section (section 2.1.15). The structure of the formatted report formats are discussed in section 3.3, and each is illustrated in Chapter 5 (MOBILE4 Examples).

3.1 PROMPTING MESSAGES

If PROMPT = 2 or 4, the user is prompted for input data in the order required by MOBILE4. Prompting messages are written to logical I/O unit 6, unless the user reassigns the prompting message unit through the IOUNEW flag (section 2.1.2). MOBILE4 does not prompt for the first record (PROMPT flag and IOUNEW unit reassignment record), since the value of the PROMPT flag determines whether or not prompting will occur.

The prompt for each record is described below. The prompting messages are printed in **boldface** in this section. See the referenced sections of Chapter 2 for detailed discussion of the prompted values.

3.1.1 Control Section Prompts

3.1.1.1 Title Record Prompt

The title record for the MOBILE4 run is prompted for by this message:

Enter project id:

3.1.1.2 16 Remaining Flag Prompts

If PROMPT = 2 (vertical format), the 16 remaining Control section flags are prompted for individually, as follows:

```
Enter TAMFLG:
Enter SPDFLG:
Enter VMFLAG:
Enter MYMRFG:
Enter NEWFLG:
Enter IMFLAG:
Enter ALHFLG:
Enter ATPFLG:
Enter RLFLAG:
Enter LOCFLG:
Enter TEMFLG:
Enter OUTFMT:
Enter PRTFLG:
Enter IDLFLG:
Enter NMHFLG:
Enter HCFLAG:
```

If PROMPT = 4 (horizontal format), the 16 remaining Control section flags are prompted for on one record, with this message:

```
Enter TAMFLG, SPDFLG, VMFLAG, MYMRFG, NEWFLG, IMFLAG, ALHFLG, ATPFLG,
RLFLAG, LOCFLG, TEMFLG, OUTFMT, PRTFLG, IDLFLG, NMHFLG, & HCFLAG
```

3.1.2 One-time Data Section Prompts

Prompts for the One-time Data section inputs have been extensively updated to correspond to MOBILE4 input requirements. All of the possible prompts for data in the One-time Data section are presented below.

3.1.2.1 Tampering Rate Prompts

If TAMFLG=2, the replacement zero-mile tampering rates (ZMLTAM) and increases in tampering with accumulated mileage, or tampering rate deterioration rates (DRTAM) are asked for by one of two possible pairs of prompts, depending on whether an inspection and maintenance (I/M) program is to be assumed (see section 2.1.9). The input requirements are discussed in section 2.2.1. If IMFLAG = 1, then these prompting messages are used:

Enter tampering intercepts (zero-mile levels) for non-I/M case only:

Enter tampering slopes (deterioration rates) for non-I/M case only:

If IMFLAG = 2, then these prompting messages are used:

Enter tampering intercepts (zero-mile levels) for non-I/M and I/M cases:

Enter tampering slopes (deterioration rates) for non-I/M and I/M cases:

3.1.2.2 VMT Mix Record Prompt

If VMFLAG = 3, the user must supply one alternate vehicle miles travelled (VMT) mix record, which will be applied to all scenarios of the MOBILE4 run. The input required is discussed in section 2.2.2. This record is prompted for by the message:

Enter VMT split:

3.1.2.3 Annual Mileage Accumulation Rates and/or Registration Distributions by Age Prompts

If MYMRFG = 2, the user must supply annual mileage accumulation rates by age for each of eight vehicle types. If MYMRFG = 3, the user must supply registration distributions by age for each of eight vehicle types. If MYMRFG = 4, the user must supply both, with the annual mileage accumulation rates preceding the registration distributions. The input requirements are discussed in section 2.2.3. These records are prompted for with the following messages (first block applicable to annual mileage accumulations, second block to registration distributions):

```
Enter MYM ages  1-10 for LDGVs:
Enter MYM ages 11-20 for LDGVs:
Enter MYM ages  1-10 for LDGT1s:
Enter MYM ages 11-20 for LDGT1s:
Enter MYM ages  1-10 for LDGT2s:
Enter MYM ages 11-20 for LDGT2s:
Enter MYM ages  1-10 for HDGVs:
Enter MYM ages 11-20 for HDGVs:
Enter MYM ages  1-10 for LDDVs:
Enter MYM ages 11-20 for LDDVs:
Enter MYM ages  1-10 for LDDTs:
Enter MYM ages 11-20 for LDDTs:
Enter MYM ages  1-10 for HDDVs:
Enter MYM ages 11-20 for HDDVs:
Enter MYM ages  1-10 for MCs:
Enter MYM ages 11-20 for MCs:

Enter MYR ages  1-10 for LDGVs:
Enter MYR ages 11-20 for LDGVs:
Enter MYR ages  1-10 for LDGT1s:
Enter MYR ages 11-20 for LDGT1s:
Enter MYR ages  1-10 for LDGT2s:
Enter MYR ages 11-20 for LDGT2s:
Enter MYR ages  1-10 for HDGVs:
Enter MYR ages 11-20 for HDGVs:
Enter MYR ages  1-10 for LDDVs:
Enter MYR ages 11-20 for LDDVs:
Enter MYR ages  1-10 for LDDTs:
Enter MYR ages 11-20 for LDDTs:
Enter MYR ages  1-10 for HDDVs:
Enter MYR ages 11-20 for HDDVs:
Enter MYR ages  1-10 for MCs:
Enter MYR ages 11-20 for MCs:
```

3.1.2.4 Alternate BER Prompts

If NEWFLG = 2, the user must supply one or more alternate basic emission rate (BER) records. The input requirements are discussed in section 2.2.4, and are summarized in Table 2.2-1. These records are prompted for with the messages:

```
Enter no. of new e.f. intercept/slope pairs:

Enter region, veh. type, pollutant, first my,
last my, intercept, slope, & above 50K miles slope:
```

The second message is repeated as many times as required, based on the number entered in response to the first prompt.

3.1.2.5 I/M Program Parameter Record Prompt

If IMFLAG = 2, the user must supply a record specifying the characteristics of the inspection and maintenance (I/M) program to be modeled. The imput requirements are discussed in section 2.2.5 and are summarized in Table 2.2-2. The twelve I/M parameters are prompted for by this message:

```
Enter the I/M Program parameter record:

 Program start year, stringency,
 first and last model year getting benefits,
 old tech waiver rate, new tech waiver rate,
 complicance rate,
 frequency of I/M inspection,
 vehicle classes covered, test type,
 flag for alternate I/M credits, Tech I&II and Tech IV+,
 the format is:
 (4(I2,1X),2(F2.0,1X),F3.0,1X,I1,
  1X,I1,1X,4I1,1X,I1,1X,2I1)
```

If the value of either or both of the flags for alternate I/M credits (the last two items of the I/M program record) is 2, the user must also supply alternate I/M credits to be read from logical I/O unit 4. MOBILE4 does <u>not</u> issue prompting messages for the I/M credit data from unit 4.

3.1.2.6 ATP Parameter Record Prompt

If ATPFLG = 2, the user must supply a record specifying the characteristics of the anti-tampering program (ATP) to be modeled. The input requirements are discussed in section 2.2.6 and are summarized in Table 2.2-3. The eight ATP parameters are prompted for by this message:

```
Enter ATP start year, first & last years included
vehicle types covered, inspection type & frequency,
compliance rate, and inspections conducted (format =
3(I2,1X),4I1,1X,2I1,1X,F4.0,1X,8I1):
```

Note that in MOBILE4 the user no longer supplies ATP emission reduction credit matrices to be read from logical I/O unit 3. MOBILE4 contains a subroutine that generates these credit matrices on the basis of the information supplied characterizing the ATP.

3.1.2.7 VRS Descriptive Record Prompt

If RLFLAG = 2, 3, or 4, the user must supply one or two records describing the refueling vapor recovery system (VRS) requirements to be modeled. The Stage II VRS record is required if RLFLAG = 2. The onboard VRS record is required if RLFLAG = 3. Both records are required if RLFLAG = 4, with the Stage II record preceding the onboard record. The input requirements are discussed in section 2.2.7 and are summarized in Table 2.2-4. The required record(s) are prompted for by one or both of these messages:

```
Enter Stage II VRS parameters -
start year, # phase-in years, LDG & HDG % efficiency:
```

```
Enter onboard VRS first model year & vehicle classes
 (I2,1X,4I1):
```

3.1.2.8 LAP Record Prompt

If LOCFLG = 2, the user must supply the local area parameter (LAP) record as part of the One-time data section, and it will be applied to all scenarios of the MOBILE4 run. Sections 2.2.8 - 2.2.13 discuss the input requirements, which are summarized in Table 2.2-5. The LAP record is prompted for by this message:

```
Enter scenario name, ASTM class, min & max daily temps,
base & in-use RVP, in-use start year:
```

3.1.3 Scenario Section Data Prompts

As discussed in section 2.3, the Scenario section consists of one to four records, depending on the values assigned to flags in the Control section. The first record, called the scenario descriptive record, is mandatory. The second, third, and fourth records are optional. All of the possible data prompting messages for the Scenario data section are presented below.

3.1.3.1 Scenario Descriptive Record Prompt

The scenario descriptive record specifies the region, calendar year of evaluation, average speed(s), ambient temperature, and operating mode fractions to be assumed for the current scenario. The input requirements are discussed in sections 2.3.1 - 2.3.5, and are summarized in Table 2.3-1.

If SPDFLG = 1, a single value of average speed is used for all vehicle types, and the record is prompted for by this message:

```
Enter region, CY, SPD(1), AMBT, PCCN, PCHC, PCCC:
```

If SPDFLG = 2, eight average speeds must be input, one for each of the eight modeled vehicle types. The record is prompted for with this message:

```
Enter region, CY, SPD(8), AMBT, PCCN, PCHC, PCCC:
```

3.1.3.2 LAP Record Prompt

If LOCFLG = 1, a distinct local area parameter record must be supplied by the user for each scenario of the run. The input requirements are discussed in sections 2.2.8 - 2.2.13, and are summarized in Table 2.2-5. The LAP record for the current scenario is prompted for by this message:

```
Enter scenario name, ASTM class, min & max daily temps,
base & in-use RVP, in-use start year:
```

3.1.3.3 VMT Mix Record Prompt

If VMFLAG = 2, a distinct VMT mix record must be supplied by the user for each scenario of the run. The input requirements are discussed in section 2.2.2. The VMT mix for the current scenario is prompted for by this message:

```
Enter VMT split:
```

3.1.3.4 Additional Light-Duty Correction Factor Record Prompt

If ALHFLG = 2 or 3, the user must supply a record used to develop and apply up to four additional correction factors to the light-duty gasoline-fueled vehicle and truck emission factors. The input requirements are discussed in section 2.3.8 and are summarized in Table 2.3-1.

If ALHFLG = 2, six input values are required, and are prompted for with this message:

```
Enter AC, XLOAD(3), TRAILR(1), ABSHUM:
```

If ALHFLG = 3, ten input values are required, and are prompted for with this message:

```
Enter AC, XLOAD(3), TRAILR(3), ABSHUM, DB, WB:
```

3.2 DIAGNOSTIC MESSAGES

3.2.1 Introduction

This section describes the MOBILE4 diagnostic messages. MOBILE4 issues three types of diagnostic messages: error messages, warning messages, and comments.

Error messages indicate either that invalid input data were entered into MOBILE4, or that MOBILE4 attempted to perform invalid operations. All error messages are prefixed by "***** Error:**". If a number follows "***** Error:**," it is the value read by MOBILE4 for the variable in error (the variable name is also printed). If the error message is due to an input value that is out of bounds, the range of acceptable values is also printed. An error will stop a MOBILE4 run.

The following errors are considered to be "fatal" errors. If any of these errors occur, no further processing of the MOBILE4 input data will be performed:

M28, M53, M60, M61, M82, M88, M89, M97, M107.

Warning messages indicate that MOBILE4 input data caused an operation not necessarily intended by the user. However, the situation is not serious enough to be labeled an error, and thus warnings will not terminate execution of the program. Users should carefully examine any warning messages issued by MOBILE4 to ascertain the accuracy of the conditions that were modeled. Comments are a type of warning message that are printed for the user's information. Neither warning nor comment messages will stop a MOBILE4 run.

The following is a list of the individual error, warning, and comment messages. In order to make the listing more useful to the MOBILE4 user, all of the messages are listed by message number (M## at the beginning of each message). MOBILE4 has been revised to print the message number as part of all diagnostic messages, allowing the user to quickly look up the message and its explanation in this section. The diagnostic messages are all printed in **boldface** in this section.

3.2.2 Explanation of Messages, Listed by Number (M##)

M 1-M 16:

M ## * Error: <value of flag> out of bounds for flag <flag name>**

One or more of these messages is printed preceding message M53 and program termination. It will appear for each of the 16 input/ output control flags which is in error. The number appearing after "*** Error:" is the value of the flag read by the program. Each of these messages indicates the value falls outside of the valid bounds for that flag. Allowable flag values are listed in Tables 2.1-1 and 2.1-2. See section 2.1.

M 17 * Error: <value of VMTMIX(IV)> out of bounds for VMTMIX (0. to 1.)**

This message is printed if a value of VMTMIX(IV) (vehicle miles travelled fraction for vehicle type IV) is not between 0. and 1. See Section 2.2.2.

M 18 * Error: <VMTMIX sum value> sum of VMTMIX is not equal to 1.**

This message is printed if the sum of VMTMIX(IV) over all vehicle types is not equal to 1. Since each VMTMIX(IV) represents the fraction of total miles that vehicle type IV contributes to the total vehicle miles traveled by the fleet, the sum of these fractions should equal 1. See Section 2.2.2.

M 19 * Error: <value of AMAR(JDX,IV)> negative model year mileage**

This message is printed if the user supplied mileage accrual data (annual mileage accumulation rate) for model year JDX and vehicle type IV is negative. All annual mileage accumulation rates must be $\geq$ 0.0. See Section 2.2.3.

M 20 * Error: <value of JULMYR(JDX,IV)> negative model year registration**

This message is printed if the registration fraction for vehicle type IV vehicles of model year JDX is negative. Since this number represents the fraction of all vehicles in the fleet of a given age, it must be between 0. and 1. inclusive. See Section 2.2.3.

M 21 Warning: <value of JULMYR> registration with zero mileage

M 22 Warning: <value of AMAR> mileage with zero registration

One of these messages is printed if, for a given vehicle age, vehicles of a given type either do not accumulate mileage yet make up a fraction of the fleet (M21), or do not make up a fraction of the fleet but accumulate mileage (M22). All vehicle type/model year combinations assumed to exist in the fleet must accumulate some mileage annually. For a given vehicle type and vehicle age, if either the mileage accumulation rate or the registration fraction is zero, both should be zero. See Section 2.2.3.

M 23 * Error: <value of NEWCT> out of bounds for e.f. changes (1 to 100 pairs)**

This message is printed if the number of emission rate modifications is not between 1 and 100. MOBILE4 is limited to handle a maximum of 100 modifications. See Table 2.2-1 and section 2.2.4.

M 24 * Error: <region code> out of bounds for region (1 or 2)**

This message is printed if the region chosen in the scenario record is not equal to 1 or 2. See section 2.3.1.

M 25 * Error: <vehicle type code> out of bounds for vehicle type (1 to 8)**

This message is printed if the vehicle type in the basic emission rate modification section is not 1, 2, 3, 4, 5, 6, 7, or 8. The eight vehicle types in MOBILE4 and their corresponding codes are:

1 = light-duty gasoline-fueled vehicles (LDGVs)
2 = light-duty gasoline-fueled trucks I (0-6000 lbs GVW) (LDGT1s)
3 = LDGTs II (6001-8500 lbs GVW) (LDGT2s)
4 = heavy-duty gasoline-fueled vehicles (8501 + lbs GVW) (HDGVs)
5 = light-duty diesel-powered vehicles (LDDVs)
6 = light-duty diesel-powered trucks (0-8500 lbs GVW) (LDDTs)
7 = heavy-duty diesel-powered vehicles (8501 + lbs GVW) (HDDVs)
8 = motorcycles (MCs).

See Table 2.2-1 and section 2.2.4.

M 26 * Error: <pollutant code> out of bounds for pollutant (1 to 3)**

This message is printed if the code for pollutant on the emission rate modification input section is not equal to 1, 2, or 3. MOBILE4 considers only 1 = hydrocarbons, 2 = carbon monoxide, and 3 = oxides of nitrogen. See Table 2.2-1 and section 2.2.4.

M 27 * Error: <value of MYFRST or MYLAST> out of bounds for year (1941 to 2020)**

This message is printed if the code corresponding to the first or last model year to have altered emission rates is not between 41 and 99 or 00 and 20 (corresponding to years 1941-2020). See Table 2.2-1 and section 2.2.4.

M 28 * Error: Excess data errors prevent further analysis.**

This message is printed if the accumulated number of data input errors exceeds 50. The run is aborted at this point. All input data should be thoroughly reviewed, and must be corrected before rerunning the program.

M 29 * Error: Last year cannot be less than first year**

This message is printed if the first model year to have its emission rates altered is less than (before) the last model year to be altered. See Table 2.2-1 and section 2.2.4.

M 30 * Error: <value of ZMLNEW> intercept must be positive"**

This message is printed if a new zero-mile emission level is ≤ 0. See Table 2.2-1 and section 2.2.4.

M 31 Warning: <value of DRNEW> negative slope for ageing vehicle

This message is printed if the value for a new exhaust deterioration rate is negative. A negative deterioration rate implies improving emissions with increasing mileage accumulation. See Table 2.2-1 and section 2.2.4.

M 32 * Error: <value of ICYIM> out of bounds for year (1960 to 2020)**

This message is printed if the code indicating the year in which an I/M program is to begin does not fall between 60 and 99, or 00 and 20 (years 1960 to 2020). See Table 2.2-2 and sections 2.2.5 and 2A.1.2.

M 33 * Error: <value of ISTRIN> out of bounds for stringency (10 to 50)**

This message is printed if the specified stringency of an I/M program for 1980 and earlier LDVs or 1984 and earlier LDTs is not between 10 and 50 (percent) inclusive. See Table 2.2-2 and sections 2.2.5 and 2A.1.3.

M 34 * Error: <value of CRIM> out of bounds for I/M Program compliance rate (0 to 100%)**

This message is printed if the specified value for compliance rate of an I/M program is not between 0 and 100 (percent) inclusive. See Table 2.2-2 and sections 2.2.5 and 2A.1.7.

M 35 * Error: <value of MODYR1> out of bounds for MODYR1 (1941 to 2020)**

This message is printed if the code representing the first model year under an I/M program is not between 41 and 99, or 00 and 20 (years 1941 to 2020). These years are the limits set by MOBILE4. See Table 2.2-2 and sections 2.2.5 and 2A.1.4.

M 36 * Error: <value of MODYR2> out of bounds for MODYR2 (1941 to 2020)**

This message is printed if the code representing the last model year under an I/M program is not between 41 and 99, or 00 and 20 (years 1941 to 2020). These years are the limits set by MOBILE4. See Table 2.2-2 and sections 2.2.5 and 2A.1.4.

M 37 * Error: MODYR1 cannot be greater than MODYR2**

This message is printed if the first model year in an I/M program is greater than the last model year in an I/M program. See Table 2.2-2 and sections 2.2.5, 2A.1.4, and 2A.1.5.

M 38 * Error: <value of CY> out of bounds for year (1960 to 2020)**

This message is printed if the calendar year to be evaluated is not between 1960 and 2020 (60 to 99 or 00 to 20) inclusive. These are the only years for which MOBILE4 evaluates emission factors. See Table 2.3-1 and section 2.3.2.

M 39 * Error: <value of SPD(I)> speed must be positive**

This message is printed if the value of average speed (if SPDFLG = 1) or any of the eight values of average speed (if SPDFLG = 2) is ≤ 0.0. See section 2.3.3.

M 40 * Error: <value of AMBT> valid ambient temperature is 0-110 deg (F)**

This message is printed if the specified value for ambient temperature value is not between 0° and 110°F. These are the limits for application of temperature correction factors. See section 2.3.4.

M 41 * Error: <value of PCCN> out of bounds for PCCN (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by non-catalyst vehicles in cold-start mode is not between 0 and 100 (percent). See section 2.3.5.

M 42 * Error: <value of PCHC> out of bounds for PCHC (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by catalyst-equipped vehicles in hot-start mode is not between 0 and 100 (percent). See section 2.3.5.

M 43 * Error: <value of PCCC> out of bounds for PCCC (0. to 100.)**

This message is printed if the input value for percentage of miles traveled by catalyst-equipped vehicles in cold-start mode is not between 0 and 100 (percent). See section 2.3.5.

M 44 * Error: <value of AC> out of bounds for AC (0. to 1.)**

This message is printed is the specified value for the fraction of air-conditioner-equipped vehicles actually using air conditioning is not between 0. and 1. inclusive. See section 2.3.8.3.

M 45 * Error: <value of XLOAD(I)> out of bounds for extra load (0. to 1.)"**

This message is printed if the specified fraction of vehicles assumed to be carrying an extra 500 lb load is not between 0. and 1. inclusive. See section 2.3.8.4.

M 46 * Error: <value of TRAILR(I)> out of bounds for trailers (0. to 1.)**

This message is printed if the specified fraction of vehicles assumed to be towing a trailer is not between 0. and 1. inclusive. See section 2.3.8.5.

M 47 * Error: <value of ABSHUM> out of bounds for humidity (20. to 140.)**

This message is printed is the specified value for absolute humidity is not between 20 and 140 inclusive. See section 2.3.8.6.

M 48 * Error: There are no sales for vehicle <vehicle name>**

MOBILE4 assumes that no significant number of LDDVs exist before 1975. Similarly, no significant number of LDDTs are assumed to exist prior to 1978. This message is printed if the user inputs a positive VMT fraction for LDDVs or LDDTs for calendar years in which they are assumed to be virtually nonexistent.

M 49 Warning: <value of CHKMYR> MYR sum not = 1. (will normalize)

This message is printed if the sum of model year registration fractions for a given vehicle type do not sum to 1. If the model year age registration fractions do not sum to 1, MOBILE4 normalizes the fractions so that do sum to 1. See Section 2.2.3.

M 50 ***Error: <value of ZEROML> out of bounds for tampering rate intercept (up to 1.0)

The zero-mileage rate of tampering cannot exceed 100% of the fleet (1.0 as a fraction) for any combination of tampering type and vehicle type. See section 2.2.1.

M 51 * Error: equation <equation number> causes more than 12 allowed for any 1 reg/veh/pol**

This message is printed if the user attempts to enter more than 12 modified basic emission rate equations for any one combination of region, vehicle type, or pollutant. See section 2.2.4.

M 52 Warning: <value of SPD> speed increased to 2.5 mph minimum

This message is printed if the average speed (SPDFLG = 1) or one or more of the eight average speeds (SPDFLG = 2) is less than 2.5 mph. MOBILE4 increases the value to 2.5 mph and continues execution. See section 2.3.3.

This message is printed if the specified average speed is < 2.5 mph. The speed correction factor equations are only valid for speeds of 2.5 through 55 mph. See section 2.3.3.

M 53 Comment: All flags must be corrected before rerunning.

This message is printed if one or more errors occur in reading the Control section flags. It should appear after a list indicating which flags are in error (see M01-M16). The run is aborted at this point. All flags in error must be corrected before the program will continue.

M 54 * Error: End-of-file return on read of unit IOUIMD (new FTP I/M credits. Run aborted.**

M 55 * Error: Error return on read of unit IOUIMD (new FTP I/M credits. Run aborted.**

These messages are printed if the user specifies alternate I/M credits are to be read in from logical I/O device unit IOUIMD, and the user either fails to supply the alternate credit data (M54) or the alternate credit data contain errors (M55). Either of these errors must be corrected before attempting to rerun the program.

M 56 Comment: A/C correction factor will be calculated.
Value of inputted AC usage parameter is ignored.

This message is printed if ALHFLG = 3 and a non-zero value for air conditioning usage fraction is entered. With ALHFLG = 3, the air conditioning usage fraction is calculated as a function of the input dry bulb and wet bulb temperatures. See sections 2.3.8.3 and 2.3.8.7.

M 57 * Error: WB temp cannot be greater than DB temp**

This message is printed if the input wet bulb temperature is greater than the input dry bulb temperature. The wet bulb temperature is always less than or equal to the corresponding dry bulb temperature. See section 2.3.8.7.

M 58 Warning: Average miles/day is zero for vehicle class <IV> and model year <value of MY>

This message is printed is BLOCK DATA Subprogram 14 has been incorrectly modified by the user.

M 59 Warning: equation <equation number> zeroes all idle coefficients (and total) for IR = <region code>, IV = <vehicle code>, IP = <pollutant code>

This message is printed when the user modifies the basic emission rate equations for the specified region, vehicle type, and pollutant. All alternative emission equations cause MOBILE4 to zero all idle emission equations corresponding to the region, vehicle type, and pollutant modified. See section 2.2.4.

M 60 *** Error: <pointer value> exceeds ub of highest myg in <index function name>

This message is printed to indicate that a default exit has been taken from an index function. This message is generated by an internal software error check, and should not occur unless the program code has been damaged. The run is aborted at this point. The program must be corrected and recompiled before another run.

M 61 *** Error: default used for <year> in index function <index function name>

This message is printed to indicate that a default exit has been taken from an index function. One or more of the associated year/years position pairs is in error. This message is generated by an internal software error check, and should not occur unless the program code has been damaged. The run is aborted at this point. The program must be corrected and recompiled before another run.

M 62 *** Error: <value of NEWREG> out of bounds for new e.f. region (1 or 2 only)

This message is printed if the region to which a modified basic emission rate applies is specified to be other than 1 (low-altitude) or 2 (high-altitude). This specification of region is independent of the region specified in the Scenario descriptive record (see section 2.3.1). See Table 2.2-1 and section 2.2.4.

M 63 *** Error: <value of sum PCHC + PCCC> out of bounds (0. ≤ PCHC + PCCC ≤ 100.)

This message is printed if the sum of the cold-start and hot-start VMT percentages for catalyst-equipped vehicles is not between 0 and 100 percent inclusive. See section 2.3.5.

M 64 *** Error: <value of sum PCHC + PCCC - PCCN> out of bounds (0. ≤ PCHC + PCCC - PCCN ≤ 100.)"

This message is printed if the sum of the cold-start and hot-start VMT percentages for catalyst-equipped vehicles less the cold-start VMT percentage for non-catalyst vehicles is not between 0 and 100 percent inclusive. See section 2.3.5.

M 65 * Error: MYR of LDDV not equal to LDGV for JDX = <JDX value>**

M 66 * Error: MYR of LDDT not equal to LDGT1 for JDX = <JDX value>**

One or both of these messages is printed if the user enters a different registration distribution by age for LDGVs than for LDDVs (M65) or for LDGT1s than for LDDTs (M66). The registration distribution by age for the total LDV (or LDT) fleet is to be input twice for the gasoline-fueled and diesel vehicles (or trucks). MOBILE4 apportions total registrations into the separate gasoline-fueled and diesel groups based on diesel sales fractions by model year. See section 2.2.3.4.

M 67 * Error: EFFTP > 0. and GSF = 0. for vehicle <vehicle name>**

This message is printed if the named vehicle type has a positive basic emission rate and a zero fleet sales fraction. See section 2.2.3.

M 68 * Error: EFFTP ≤ 0. AND VMTMIX > 0. for vehicle <vehicle type>**

This message is printed if no exhaust emission rates exist for the named vehicle type, but vehicles of that type have accumulated a nonzero fraction of the total vehicle fleet mileage.

M 69 * Error: EFIDLE > 0. and GSF = 0. for vehicle <vehicle type>**

This message is printed if the named vehicle type has a positive idle emission rate and a zero fleet sales fraction. See section 2.2.3.

M 70 * Error: EFIDLE ≤ 0. AND VMTMIX > 0. for vehicle <vehicle type>**

This message is printed if no idle emission rates exist for the named vehicle type; but vehicles of that type have accumulated a nonzero fraction of the total vehicle fleet mileage.

M 71 Comment: Current output unit numbers are:
IOUREP = "formatted report unit"
IOUERR = "error/warning/comment unit"
IOUASK = "prompt message unit"

This message is printed whenever any of the default output unit numbers are reassigned using the IOUNEW record in the Control section. See section 2.1.2.

M 72 * Error: <Value of ILDT(I)> out of bounds for I/M vehicle type (1 to 2)**

This message is printed if the value of ILDT(I) is not 1 or 2 in the I/M program descriptive record. See Table 2.2-2.

M 73 * Error: <value of ITEST> out of bounds for short test type flag (1 to 3)**

This message is printed if the value of ITEST (Technology IV+ short test type) is not 1, 2 or 3. See Table 2.2-2.

M 74 * Error: <Value of NUDATA> out of bounds for new I/M data flag (1 or 2)**

This message is printed if the value of the NUDATA flag (the flag from the I/M program descriptive record indicating whether or not new I/M credits are to be read from unit IOUIMD) is not 1 or 2. See Table 2.2-2.

M 75 * Error: <value of LAPSY> out of bounds for anti-tampering program start year**

This message is printed if the value of the ~~start year~~ for the selected anti-tampering program (ATP) is not in the range 1960 to 2020 (60 to 99 or 00 to 20). See Table 2.2-3 and section 2A.1.2.

M 76 * Error: <value of LAP1ST> out of bounds for anti-tampering program 1st model year**

This message is printed if the value of the first model year included in the selected ATP is not in the range 1941 to 2020 (41-99 or 00-20). See Table 2.2-3 and section 2A.1.4.

M 77 * Error: <value of LAPLST> out of bounds for anti-tampering program last model year**

This message is printed if the value of the last model year included in the selected ATP is not in the range 1941 to 2020 (41-99 or 00-20). See Table 2.2-3 and section 2A.1.5.

M 78 * Error: <value of LVTFLG(I)> out of bounds for anti-tampering vehicle type (1 or 2)**

This message is printed if the value entered for the ATP vehicle class inclusion flag for vehicle type I is not either 1 (not covered) or 2 (covered). See Table 2.2-3.

M 79 * Error: <value of EVP> out of bounds for evap ATP effectiveness rate (0. to 1.)**

This message is printed if the value calculated for the evaporative ATP effectiveness rate in the ATP effectiveness rate matrices generated by MOBILE4 is not in the range 0.0 to 1.0. These rates act as percentage credits, and hence must be nonnegative and not exceed unity.

M 80 * Error: <value of RATE> out of bounds for exh ATP effectiveness rate (0. to 1.)**

This message is printed if the value calculated for the exhaust ATP effectiveness rate in the ATP effectiveness rate matrices generated by MOBILE4 is not in the range 0.0 to 1.0. These rates act as percentage credits, and hence must be nonnegative and not exceed unity.

M 81 * Error: <value of COLSUM> out of bounds for AER matrix file column sum (0. to 1.)"**

This message is printed if any column of each of the 4 exhaust ATP effectiveness rate matrices generated by MOBILE4 on the basis of the ATP descriptive input record does not sum to a nonnegative value not exceeding unity.

M 82 * Error: <value of INTYP> out of bounds for type of I/M inspection (1 (centralized) or 2 (computerized decentralized) or 3 (manual decentralized))**

This message is printed if the value of the I/M program type specified in the I/M program descriptive record is not 1, 2, or 3. The run is aborted at this point. See Table 2.2-2, and sections 2.2.5, 2A.1.12, 2A.1.13, and 2A.1.14.

M 83 Comment: One or more evaporative temperatures (input daily maximum, input ambient, calculated hot soak, and/or calculated running loss) is 40F or less, or the input daily minimum is 25F or less; no evaporative emission factors (hot soak, diurnal, running loss, or refueling) will be calculated.

This message is printed if (i) TEMFLG = 1 and one or more of the temperatures calculated by MOBILE4 for correction of emissions, or (ii) TEMFLG = 2 and the input ambient temperature, is less than or equal to 40°F; or (iii) the input daily minimum temperature is less than or equal to 25°F. See sections 2.1.13 and 2.2.11.5 for additional information. The crankcase emissions will still be calculated, resulting in a small non-zero evaporative emission factor representing crankcase emissions only.

M 84 * Error: <Value of IVOB(I)> out of bounds for onboard VRS vehicle class flag (1 to 2)**

This message is printed if the value of the IVOB flag for vehicle type I indicating whether or not the vehicle type is subject to the requirements of an onboard VRS system is not 1 or 2. See Table 2.2-4 and section 2.2.7.

M 85 Message slot 85 is not assigned in MOBILE4.

M 86 * Error: <value of NPHASE> out of bounds for no. of stage II phase-in years (1 to 5)**

This message is printed if the value of NPHASE in the Stage II VRS descriptive record is not between 1 and 5. See Table 2.2-4 and section 2.2.7.

M 87 * Error: <value of IS2SY or IOBMY or IUSESY> out of bounds for VRS or RVP controls start year**

This message is printed if any of the specified start years for Stage II VRS, onboard VRS, or in-use volatility (RVP) is not between 1989 and 2020 (89-99 and 00-20). See sections 2.2.7 and 2.2.13.

M 88 * Error: Message code <message code value> unknown**

This message should only be printed when the message printing subroutine QUITER is passed an undefined message code value. The run is aborted at this point.

M 89 * Error: <value of PROMPT> out of bounds for flag PROMPT.**

This message is printed if PROMPT does not equal 1, 2, 3, or 4. The run is aborted at this point, and this correction must be made before the program will proceed. See section 2.1.1.

M 90 Warning: <Value of RVP> RVP is reset to <new value>

This message is printed if the input value for either base or in-use RVP, or the value of either of these after fuel weathering is accounted for, is outside of the input RVP limits of 7.0 to 15.2 psi inclusive; or, if the value of RVP to be used in the diurnal or hot soak evaporative emission factor calculation exceeds an upper limit for each that depends on the temperature(s) to be used in that calculation. See Table 2.2-5 and sections 2.2.12 and 2.2.13. The value printed first is reset by MOBILE4 to <new value> before the emission factors are calculated.

M 91 * Error: <value of TEMMIN> out of bounds for minimum daily temperature**

- or -

M 91 * Error: <value of TEMMAX> out of bounds for maximum daily temperature**

One of these messages is printed if either the input minimum or maximum daily temperature is outside the limits set by MOBILE4 ($0 \leq \text{minimum} \leq 100$, $10 \leq \text{maximum} \leq 120$). See Table 2.2-5 and section 2.2.11.

M 92 * Error: Max daily temp = <value of TEMMAX> < min daily temp**

This message is printed if the minimum daily temperature is greater than the maximum daily temperature. See section 2.2.11.

M 93 Message slot 93 is not assigned in MOBILE4.

M 94 * Error: <Value of ASTMCL> out of bounds for ASTM volatility Class (A-E)**

This message is printed if a value other than one of the five letters A/B/C/D/E is entered for the ASTM volatility class on the local area parameter record. See Table 2.2-5 and section 2.2.10.

M 95 * Error: Ambient temperature = <value of AMBT> is < daily min temp or > daily max temp**

This message is printed if the ambient temperature (see section 2.3.4) is either less than the minimum daily temperature or greater than the maximum daily temperature (see section 2.2.11).

M 96 Warning: <Value of SPD(I)> speed reduced to 55 mph maximum

This message is printed if the average speed (SPDFLG = 1) or one or more of the eight average speeds (SPDFLG = 2) is greater than 55 mph. MOBILE4 reduces the value to 55 mph and continues execution. See section 2.3.3.

M 97 * Error: <Value of A> out of bounds for Wade Index calculation (CALUDI) of A, pass <value of JV>: must be $\geq$ 0.0**

This message is printed if an unrealistic combination of very high fuel volatility (RVP) and temperature values are used in the calculation of diurnal evaporative emissions. The run is aborted at this point. Re-check all input RVP and temperature values. See sections 2.2.11 - 2.2.13.

M 98 Warning: Diurnal temperature rise (max temp - min temp = <value>) is > 40F; diurnal evaporative emission factors will be calculated, but may be inaccurate.

This message is printed if the difference in the input daily minimum and maximum temperatures is greater than 40 F°. See section 2.2.11.5.

M 99 * Error: <Value of PCTEL> out of bounds for Stage II efficiency for LDGV (0 to 100%) or <Value of PCTEH> out of bounds for Stage II efficiency for HDGV (0 to 100%)**

This message is printed if the specified value for the efficiency of Stage II VRS at controlling refueling emissions from LDGVs and LDGTs, or from HDGVs, is not between 0 and 100 percent. See Table 2.2-4 and section 2.2.7.

M100 * Error: <Value of WAIVER(1) or WAIVER(2)> out of bounds for I/M Program waiver rate (0 to 50%)**

This message is printed if the values specified for either waiver rate for I/M programs on the I/M program descriptive record is not between 0 and 50 percent inclusive. See Table 2.2-2 and sections 2.2.5 and 2A.1.6.

M101 * Error: <Value of IFREQ> out of bounds for frequency of I/M inspection (1 (annual) or 2 (biennial))**

This message is printed if the value of IFREQ specified on the I/M program descriptive record is not 1 or 2. See Table 2.2-2 and sections 2.2.5 and 2A.1.8.

M102 Warning: High altitude I/M scenario requires user to supply high altitude values for Tech 1&2 I/M credits arrays

This message is printed if the user specifies high-altitude as the region for which emission factors are to be calculated and also specifies that an I/M program is to be assumed. The I/M credits contained in the MOBILE4 code are applicable only to low-altitude regions. The MOBILE4 tape includes standard high-altitude region I/M credit matrices, which must be read in on logical I/O unit 3.

M103 * Error: <Value of ATPPGM> out of bounds for type of ATP program (1 (centralized) to 2 (decentralized))**

This message is printed if the value of the ATPPGM flag on the ATP descriptive record, indicating the type of ATP to be modeled, is not 1 or 2. See Table 2.2-3 and sections 2.2.6, 2A.1.12, 2A.1.13.

M104 * Error: <Value of ATPFQT> out of bounds for frequency of ATP inspection (1 (annual) to 2 (biennial))**

This message is printed if the value of the ATPFQT flag on the ATP descriptive record, indicating the frequency of inspection in the ATP to be modeled, is not 1 or 2. See Table 2.2-3 and sections 2.2.6 and 2A.1.8.

M105 * Error: <Value of CRATP> out of bounds for ATP compliance rate, must be in the range 0.% to 100.%, inclusive**

This message is printed if the specified ATP compliance rate is not between 0 and 100 percent inclusive. See Table 2.2-3 and sections 2.2.6 and 2A.1.7.

M106 * Error: <Value of DISTYP(I)> out of bounds for ATP disablement inspections (1 (no) or 2 (yes))**

This message is printed if the value of any of the eight DISTYP flags on the ATP descriptive record, indicating whether or not each of eight possible types of inspections are performed, is not 1 or 2. See Table 2.2-3, and sections 2.2.6 and 2A.2.3 through 2A.2.10.

M 107 * Error: Error reading ATP program description in the ONE-TIME data section**

This message is printed if there is an error in reading the ATP descriptive record. The run is aborted at this point. Check the formats and all input values closely. See Table 2.2-3.

M108 Warning: The ATP compliance rate of <value of CRATP> is not equal to the I/M compliance rate of <value of CRIM>

This message is printed if the specified ATP compliance rate is not equal to the specified I/M compliance rate. The program will continue execution, but since such programs are generally run in conjunction in a given area, the compliance rates generally should be equal for both programs. See sections 2.2.5. 2.2.6, and 2A.1.7.

M109 Warning: The ATP inspection frequency is <value of ATPFQT> and the I/M inspection frequency is <value of IFREQ>

This message is printed if the specified ATP inspection frequency is not equal to the specified I/M inspection frequency. The program will continue execution, but since such programs are generally run in conjunction in a given area, the frequency of inspection generally should be the same for both programs. See sections 2.2.5. 2.2.6, and 2A.1.8.

M110 Warning: The ATP inspection type is <value of ATPPGM>, the I/M inspection type is <value of INTYP>

This message is printed if the specified ATP program type (i.e., centralized or decentralized) is not the same as the specified I/M program type. The program will continue execution, but since such programs are generally run in conjunction in a given area, the program type generally should be the same for both programs. See sections 2.2.5. 2.2.6, 2A.1.12, and 2A.1.13.

M111 * Error: <Value of exhaust correction temperature or hot soak, running loss, or diurnal correction temperature> is < min daily temp or > max daily temp**

This message is printed if TEMFLG = 1 and one of the temperatures calculated for correction of exhaust, evaporative, or running loss emissions is outside of the range of the specified minimum and maximum daily temperatures. Since these calculations use the input minimum and maximum daily temperatures to start with, this is an internal error check. If this message appears, and the minimum and maximum daily temperatures are correct and meet all of the necessary conditions, damage has occurred to either the source code or the compiled program. Recompile and attempt the run again.

3.3 FORMATTED REPORT OUTPUT

There are four different types of formatted report output. The user specifies which of the four is to be generated through assignment of a value to the OUTFMT flag in the Control section (section 2.1.15). If OUTFMT = 1 or 2, MOBILE4 generates a formatted data set suitable for use as an input file for subsequent computer analysis ("numeric" output). If OUTFMT = 3 or 4, a report more suitable for visual inspection and analysis ("descriptive" format) is generated. These latter outputs are designed to provide a well-annotated record of the user's analysis.

All four types of formatted report output have been revised extensively since MOBILE3 to account for the numerous changes to the model, its input requirements, and its output. Maintaining compatibility of the MOBILE4 output files with those generated by earlier versions of the emission factor model was not possible, due to the many changes to both the input stream and the output information. Thus, the user is advised to review the detailed descriptions of each of the four output formats carefully, particularly the numeric formats used as input for other models and computer programs.

3.3.1 221-Column Numeric Format (OUTFMT = 1)

If OUTFMT = 1, the longest numeric format report is generated. It consists of four heading records, which provide minimal column descriptions, followed by one to ten records per scenario evaluated. The number of records produced for each scenario is determined by the values assigned to the PRTFLG, IDLFLG, and HCFLAG flags in the Control section (sections 2.1.16, 17, 19).

Table 3.3-1 shows the number of records produced per scenario evaluated and the content of the records, for each legitimate combination of values of the PRTFLG, IDLFLG, and HCFLAG flags.

Each record of this output format consists of 35 subject columns. (In the description that follows, the term "column" is used to refer to the subject columns, while the term "character" is used to refer to the number of individual, one-space columns spanned by the subject column.) Example 1A in Chapter 5 is illustrates this output format. The subject columns and the value(s) shown in each are described below:

One other item to note with respect to the numeric output formatted report options is the "carraige control" characters used to control the placement of records. FORTRAN incorporates a character in column 1 of each output record which is used to indicate carraige control (such as "start new page," "double-space before printing next record," and similar instructions). If OUTFMT = 1 or 2 and the formatted report is directed to a line file, the first character space is reserved for this carraige control character. Thus, all of the columns that follow in each record are shifted one character space to the right:

Format	Content
1X	(carraige control character)
I1	(Column 1: Region)
1X,I2	(Column 2: CY of evaluation), etc.

The total record length is then 221 columns (OUTFMT = 1) or 140 columns (OUTFMT = 2).

If the numeric output formatted report is directed to a printer, such as was done in generating examples 1a and 1b in section 5.1.1, the instructions provided by the carraige control characters are executed, but the characters are not printed and no space is reserved for them on the hard copy. Thus, the format of the printed version of OUTFMT = 1 or 2 reports does not begin with 1X (carraige control character), and the total length of each record is 220 columns (OUTFMT = 1) or 139 columns (OUTFMT = 2).

Column 1: Region. The column is one character wide (format I1). The column heading is "Reg" (printed vertically). The value shown is either 1 (low-altitude) or 2 (high-altitude). This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.1.

Column 2: Calendar year of evaluation. The column is three characters wide (format 1X,I2). The column heading is "CY". The value shown is the last 2 digits of the calendar year of evaluation. (Note that CY 2000 appears as "0", not "00".) This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.2.

Columns 3-10: Vehicle Speeds. The column is 40 characters wide (format 8F5.1). The column heading is "Vehicle Speeds". The values shown are the average speeds used for each of the eight vehicle classes, in this order: LDGV, LDGT1, LDGT2, HDGV, LDDV, LDDT, HDDV, MC. If SPDFLG = 1, all eight speeds have the same value. In print, the values are separated by slashes (/). For example, if SPDFLG = 1 and speed = 19.6 mph, this line appears:

```
19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6
```

This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.3.

Column 11: Ambient Temperature. The column is four characters wide (format 1X,I3). The column heading is "Amb Tem" on two lines. The value(s) that appear in this column depend on the value of TEMFLG: If TEMFLG = 1, the temperature(s) calculated by MOBILE4 based on the input minimum and maximum daily temperatures for the correction of exhaust HC, CO, and NOx emission factors are printed on the applicable line. If TEMFLG = 2, the input ambient temperature is echoed back on the exhaust emission factor records. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records (evaporative, refueling, and running loss). See sections 2.1.14, 2.2.11, and 2.3.4.

Columns 12-14: Operating Mode Fractions. The column is 18 characters wide (format 3F6.1). The column heading is "Cold/Hot Start". The values that appear are the input values for PCCN, PCHC, and PCCC, in that order. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.5.

Column 15: Altitude. The column is 7 characters wide (format F7.0). The column heading is "Alt. in Ft." on two lines. This feature is residual from earlier versions of the model. The value that appears is either 500. (if the input region is 1 (low-altitude)), or 5500. (if the input region is 2 (high-altitude)). This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 16: Pollutant. The column is two characters wide (format 1X,A1). The column heading is "Pol" printed vertically. The values and their corresponding identification of pollutants are:

Value	Pollutant	Value	Pollutant
1	Total HC	X	Exhaust HC
2	Exhaust CO	V	Evaporative HC (includes crankcase)
3	Exhaust NOx		
4	Idle HC	R	Refueling HC
5	Idle CO	T	Running loss HC
6	Idle NOx		

See sections 2.1.16, 2.1.17, 2.1.19, and Table 3.3-1.

Columns 17-26: Composite Emission Factors. The next ten columns are each eight characters wide (format 10F8.3). The column headings are "Composite Emission Factors" centered over all 80 characters, with the individual columns headed in order by: "LDGV", "LDGT1", "LDGT2", "LDGT", "HDGV", "LDDV", "LDDT", "HDDV", "MC", and "All Veh". These represent the emission factors for the pollutant identified in column 16, for the following vehicle classes in order: light-duty gasoline-fueled vehicles, light-duty gasoline-fueled trucks 1 (up to 6,000 lbs), light-duty gasoline-fueled trucks 2 (6,001-8,500 lbs), all LDGTs together (weighted results for LDGT1s and LDGT2s), heavy-duty gasoline-fueled vehicles (over 8,500 lbs), light-duty diesel vehicles, light-duty diesel trucks (up to 8,500 lbs), heavy-duty diesel vehicles (over 8,500 lbs), motorcycles, and all vehicles combined (weighted by the VMT mix; see columns 27-34 below). The emission factors are listed to 3 decimal places (0.001 g/mi) in this type of formatted report.

Columns 27-34: VMT Mix. The next eight columns are each six characters wide (format 8F6.3). The column headings are "Vehicle Mix" centered over all 48 columns, with the individual columns headed in order by: "LDGV", "LDGT1", "LDGT2", "HDGV", "LDDV", "LDDT", "HDDV", and "MC". The values are the VMT mix input by the user for the current scenario. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

Column 35: Scenario Title. The column is 17 characters wide (format 1X,4A4). The heading is "Scenario Title". The value is the echo of the scenario title input as part of the Local Area Parameter record. See sections 2.2.8 and 2.2.9, and Table 2.2-5.

3.3.2 140-Column Numeric Format (OUTFMT = 2)

If OUTFMT = 2, a somewhat shorter numeric format report is generated. As in the case of the longer 222-column numeric format report, it consists of four heading records providing minimal column descriptions, followed by one to ten records per scenario evaluated. The number of records produced for each scenario is determined by the values assigned to the PRTFLG, IDLFLG, and HCFLAG flags in the Control section (sections 2.1.16, 17, 19). Table 3.3-1 shows the number of records produced per scenario evaluated and the content of the records, for each legitimate combination of values of the PRTFLG, IDLFLG, and HCFLAG flags.

Each record of this output format consists of 25 subject columns. (In the description that follows, the term "column" is used to refer to the subject columns, while the term "character" is used to refer to the number of individual, one-space columns spanned by the subject column.) Example 1b in Chapter 5 illustrates this output format. Note that this output will be truncated after a maximum of 132 columns if printed in landscape format on standard 8.5x11 inch paper unless wrapped around. See the discussion of carraige control characters provided in section 3.1.1, which is also applicable in this case. The subject columns and the value(s) shown in each are described below:

Column 1: Region. The column is one character wide (format I1). The column heading is "Reg" (printed vertically). The value shown is either 1 (low-altitude) or 2 (high-altitude). This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.1.

Column 2: Calendar year of evaluation. The column is three characters wide (format 1X,I2). The column heading is "CY". The value shown is the last 2 digits of the calendar year of evaluation. (Note that CY 2000 appears as "0", not "00".) This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.2.

Column 3: Ambient Temperature. The column is five characters wide (format 1X,I3,1X). The column heading is "Amb Tem" on two lines. The value(s) that appear in this column depend on the value of TEMFLG: If TEMFLG = 1, the temperature(s) calculated by MOBILE4 based on the input minimum and maximum daily temperatures for the correction of exhaust HC, CO, and NOx emission factors are printed on the applicable lines. If TEMFLG = 2, the input ambient temperature is echoed back on the exhaust emission factor records. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records (evaporative, refueling, and running loss). See sections 2.1.14, 2.2.11, and 2.3.4.

Columns 4-6: Operating Mode Fractions. The column is 18 characters wide (format 3F6.1). The column heading is "Cold/Hot Start". The values that appear are the input values for PCCN, PCHC, and PCCC, in that order. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records. See section 2.3.5.

Column 7: Pollutant. The column is two characters wide (format 1X,A1). The column heading is "Pol" printed vertically. The values and their corresponding identification of pollutants are:

Value	Pollutant	Value	Pollutant
1	Total HC	X	Exhaust HC
2	Exhaust CO	V	Evaporative HC (includes crankcase)
3	Exhaust NOx	R	Refueling HC
4	Idle HC	T	Running loss HC
5	Idle CO		
6	Idle NOx		

See sections 2.1.16, 2.1.17, 2.1.19, and Table 3.3-1.

Columns 8-17: Composite Emission Factors. The next ten columns are each eight characters wide (format 10F8.3). The column headings are "Composite Emission Factors" centered over all 80 characters, with the individual columns headed in order by: "LDGV", "LDGT1", "LDGT2", "LDGT", "HDGV", "LDDV", "LDDT", "HDDV", "MC", and "All Veh". These represent the emission factors for the pollutant identified in column 7, for the following vehicle classes in order: light-duty gasoline-fueled vehicles, light-duty gasoline-fueled trucks 1 (up to 6,000 lbs), light-duty gasoline-fueled trucks 2 (6,001-8,500 lbs), all LDGTs together (weighted results for LDGT1s and LDGT2s), heavy-duty gasoline-fueled vehicles (over 8,500 lbs), light-duty diesel vehicles, light-duty diesel trucks (up to 8,500 lbs), heavy-duty diesel vehicles (over 8,500 lbs), motorcycles, and all vehicles combined (weighted by the VMT mix; see columns 18-25 below). The emission factors are listed to two decimal places (0.01 g/mi) in this type of formatted report.

Columns 18-25: VMT Mix. The next eight columns are each six characters wide (format 8F6.3). The column headings are "Vehicle Mix" centered over all 48 columns, with the individual columns headed in order by: "LDGV", "LDGT1", "LDGT2", "HDGV", "LDDV", "LDDT", "HDDV", and "MC". The values are the VMT mix input by the user for the current scenario. This column contains values on all exhaust emission factor records, but is blank for the component HC emission factor records.

3.3.3 112-Column Descriptive Format (OUTFMT = 3)

If OUTFMT = 3, a well-annotated descriptive format output is produced. This format is designed for ease of visual inspection, with more complete labeling and heading information. The 112-column width allows this format to be printed in landscape format (sideways) on standard 8.5x11 paper.

The exact content of the report is determined by a number of flag settings. Information applicable to the entire run (all scenarios) is listed first, followed by a series of blocks, one per scenario evaluated. The scenario output blocks are separated by solid lines.

Each possible component of this output format is briefly described below. Example 1c in Chapter 5 is an illustration of this type of output.

The first line of the report is the project title input by the user (section 2.1.1). This is followed by a blank line, then by the following optional information if applicable:

If the output units have not been reassigned (section 2.1.2), then any diagnostic messages generated will follow the project title.

If an I/M program is to be modeled (IMFLAG = 2), a block echoing the descriptive information on the I/M program will be printed. This block consists of 16 lines. For example:

```
I/M program selected:

     Start year (January 1):                   1981
     Pre-1981 MYR stringency rate:              20%
     First model year covered:                 1965
     Last model year covered:                  2020
     Waiver rate (pre-1981);                   10.%
     Waiver rate (1981 and newer):             10.%
     Compliance rate:                          80.%
     Inspection type:                          Centralized
     Inspection frequency:                     Annual
     Vehicle types covered:                     LDGV - Yes
                                               LDGT1 - Yes
                                               LDGT2 - Yes
                                                HDGV - No
     1981 & later MYR test type:               Idle
```

If the user has supplied alternate I/M credits, then a message indicating this can be printed following this block. This message must be provided in the alternate I/M credit file to be read from logical I/O unit 4.

If the user has selected modeling of the effects of an anti-tampering program (ATP), the program description is echoed. This block consists of 19 lines. For example:

```
Anti-tampering program selected:

     Start year (January 1):                      1981
     First model year covered:                    1970
     Last model year covered:                     2020
     Vehicle types covered:                       LDGV

     Type:                                        Centralized
     Frequency:                                   Annual
     Compliance Rate:                             90.0%

     Air pump system disablements:                Yes
     Catalyst removals:                           Yes
     Fuel inlet restrictor disablements:          Yes
     Tailpipe lead deposit test:                  No
     EGR disablements:                            Yes
     Evaporative system disablements:             Yes
     PCV system disablements:                     Yes
     Missing gas caps:                            No
```

If both I/M and anti-tampering programs are selected, the I/M block precedes the ATP block in the output.

If alternate basic emission rates are modeled (NEWFLG = 2), message M59 (see section 3.2.2) will be printed, followed by a table summarizing the changes made to the BERs. For example:

```
                   Emission Factor Modification Profile
Equation Reg Veh Pol First MY Last MY    Base   DR    50K DR Altered
    1     2   1   2    1980     1986    30.05  3.01    3.44    Yes
```

If one local area parameter record is to be applied to all scenarios (LOCFLG = 2), this information is printed on the next two lines. The first line lists the scenario name, ASTM class, and minimum and maximum daily temperatures. The second line lists the base RVP, in-use RVP, and in-use start year. Each of these is clearly indicated with a label.

Finally, one of the following messages will be printed before the individual scenario results. If NMHFLG = 1: "Total HC emission factors include evaporative HC emission factors", and if NMHFLG = 2: "Non-methane HC emission factors include evaporative HC emission factors".

The above information is followed by a series of scenario output blocks, separated for each scenario by solid lines. Each of these blocks has the same format and structure.

After the line indicating the start of a scenario output block, the following one-line messages are printed if applicable to that scenario:

If TAMFLG = 2:

"User supplied tampering and misfueling rates"

If MYMRFG = 2:

"User supplied mileage accrual distributions"

If MYMRFG = 3:

"User supplied veh registration distributions"

If MYMRFG = 4:

"User supplied mileage accrual distributions, veh registration distributions"

These messages are followed by two lines describing the secenario being modeled. The first line includes the calendar year of evaluation, whether or not an I/M program is modeled, the ambient temperatures used to correct exhaust HC, CO, and NOx emissions, and the region (low- or high-altitude). The second line includes whether or not an ATP is modeled, the operating mode fractions, and the altitude (500 ft for low-altitude and 5500 ft for high-altitude). Each of these is clearly labeled. The three ambient temperatures apply, in order, to HC, CO, and NOx.

Two additional lines containing the local area parameter record information follow, if LOCFLG = 1 (separate local area parameter record for each scenario). The first line lists the scenario name, ASTM class, and minimum and maximum daily temperatures. The second line lists the base RVP, in-use RVP, and in-use start year. Each of these is clearly indicated by a label.

The next line starts with "Veh. Type:" and continues across with ten column headings. In order, these are LDGV, LDGT1, LDGT2, LDGT, HDGV, LDDV, LDDT, HDDV, MC, and All Veh. The remaining lines in the output each consist of an identifier at left, with the values for that line, for each of the ten vehicle types or groups, following under the appropriate headings.

The next line is "Veh. Speeds:", with values entered only in the eight columns for which vehicle average speed is used to correct the emission factors. The next line is "VMT Mix:", with VMT fractions by vehicle class entered in the appropriate columns. (No speed or VMT Mix values will appear under the combined LDGT1 and LDGT2 "LDGT" column or the "All Veh" column.)

The next line reads "Composite Emission Factors (Gm/Mile)". This line precedes a set of one to seven lines of emission factors, depending on the pollutants to be printed (PRTFLG) and whether component HC emission factors are to be printed (HCFLAG). If all seven lines appear, they are in the following order:

Label	Content
Total HC:	Total or Non-methane HC emission factor (EF), including all components (whether or not they are listed individually)
Exhaust HC:	Exhaust HC component EF
Evaporat HC:	Evaporative HC component EF (includes crankcase emissions)
Refuel L HC:	Refueling loss HC component EF
Runing L HC:	Running loss HC component EF
Exhaust CO:	Exhaust CO EF
Exhaust NOx:	Exhaust NOx EF

Unless the idle emission factors have been requested, this completes the block for an individiual scenario. If IDLFLG = 2, indicating that idle emission factors are to be printed, the following identifying line is printed: "Hot Stabilized Idle Emission Factors (Gm/Hr)". This is followed by one to three additional lines, depending on the pollutants to be listed. These lines are labeled "Idle HC:", "Idle CO:", and "Idle NOx:".

3.3.4 80-Column Descriptive Format (OUTFMT = 4)

If OUTFMT = 4, a well-annotated descriptive format output similar to that described in section 3.3.3 is produced. This format is also designed for ease of visual inspection, with complete labeling and heading information. The 80-column width allows this format to be printed in portrait format (vertically) on standard 8.5x11 paper.

The exact content of the report is determined by a number of flag settings. Information applicable to the entire run (all scenarios) is listed first, followed by a series of blocks, one per scenario evaluated. The scenario output blocks are separated by solid lines. Example 1d in Chapter 5 is an illustration of this type of output.

This output follows the order of information presented in section 3.3.3 above, with additional lines and minor format changes required in some cases to accomodate all of the information in the narrower overall width. Refer to Example 1d in section 5.1.1 and the desciptions provided above.

Table 3.3-1

Number and Content of Records per Scenario
(222-column and 140-column numeric output formats)

Flag Values*			Records/ Scenario	Content (in order of listing)
PRTFLG	IDLFLG	HCFLAG		
1	1	1	1	Total HC
1	1	2	5	Total HC, exhaust (exh) HC, evaporative (evap) HC, refueling HC, running loss HC
1	2	1	2	Total HC, idle HC
1	2	2	6	Total HC, exh HC, evap HC, refueling HC, running loss HC, idle HC
2	1	1**	1	Exh CO
2	2	1**	2	Exh CO, idle CO
3	1	1**	1	Exh NOx
3	2	1**	2	Exh NOx, idle NOx
4	1	1	3	Total HC, exh CO, exh NOx
4	1	2	7	Total HC, exh HC, evap HC, refueling HC, running loss HC; exh CO; exh NOx
4	2	1	6	Total HC; exh CO; exh NOx; idle HC; idle CO; idle NOx
4	2	2	10	Total HC, exh HC, evap HC, refueling HC, running loss HC; exh CO; exh NOx; idle HC; idle CO; idle NOx

---

* PRTFLG: 1 = HC only, 2 = CO only, 3 = NOx only, 4 = HC, CO, & NOx
IDLFLG: 1 = No idle emission factors, 2 = include idle EFs
HCFLAG: 1 = Total HC only, 2 = Total and component HC EFs

** HCFLAG = 1 (do not print components of HC emission factor) is mandatory if PRTFLG = 2 (CO only) or 3 (NOx only).

Chapter 4

MOBILE4 IMPLEMENTATION

4.0 INTRODUCTION

This chapter contains information on the MOBILE4 tape, and other information that may be useful to users interested in the computer resource requirements of MOBILE4, to users implementing MOBILE4 on their own computer systems, and to users who are considering making software changes. It also contains instructions on how to port the mainframe version of the code to personal computers (MacIntosh, and IBM PC-AT or clone).

4.1 MOBILE4 TAPE

The MOBILE4 tape released by EPA contains four files. The first file is the MOBILE4 source code in mixed-case lettering (upper and lower). The second file is exactly the same as the first file, except it is an uppercase-only lettering version. This second file has been provided in the event some systems have difficulty with lowercase characters. The mixed-case version is more easily read than the all-uppercase version.

The third file is a copy of the input files used to generate the User's Guide examples of Chapter 5, in uppercase. These examples can be used to verify that MOBILE4 is operating properly when installed on a new system.

The fourth file on the tape is a set of standard parameter inpsection and maintenance (I/M) program credits applicable to high-altitude areas. The I/M credits stored in the MOBILE4 code are applicable only to low-altitude areas. This file has the same structure as is used for the credits contained in the code, but for high-altitude areas. See section 2.2.5 and Appendix 2A.

Note that the file that contained anti-tampering program credit matrices, which was included on the MOBILE3 tape, has no counterpart on the MOBILE4 tape. This is because MOBILE4 has been revised to include a subroutine that generates the necessary credit matrices on the basis of the ATP descriptive information provided by the user. See section 2.2.6 and Appendix 2A.

Other characteristics of the MOBILE4 tape are presented in Table 4.1-1.

Table 4.1-1

MOBILE4 Tape Characteristics

Density: 1600 bpi
Blocking: 4000
Record Length: 80
Character Set: EBCDIC
Total Length: 168.33 feet
Unlabeled

File Number	Description	Number of Records	Block Count	Tape Length (Feet)
1	MOBILE4 Source Code (Mixed-case letters)	21,296	426	112.17
2	MOBILE4 Source Code (Uppercase)	21,296	426	112.17
3	Input Files for *User's Guide* Examples	207	5	1.45
4	I/M Credit Matrices (for high-altitude areas)	406	9	2.49

4.2 PROGRAM STORAGE REQUIREMENTS

The wide variety of computers and system configurations in use prohibits a precise statement of main storage requirements on each system. Nevertheless, the following should be representative of the requirements of MOBILE4 on most systems.

	Kilobytes	32-bit memory words
Source Code	920	235,520
Object Code	608	155,648

The standard convention of 1 kilobyte = 1024 bytes is used. The values were obtained from the implementation of MOBILE4 on the Michigan Terminal System at Wayne State University, based on an Amdahl 5890-180E computer.

4.3 PROGRAM EXECUTION TIME

MOBILE4 requires more time to process scenario records than does MOBILE3. This was expected due to the extensive revisions made to the program, including the additions of many subroutines and the increased complexity of many of the computational algorithms used. Table 4.3-1 provides a comparison of the execution time required by MOBILE4 and MOBILE3 to process input data containing varying numbers of scenarios.

Table 4.3-1

Comparison of MOBILE4 and MOBILE3 Execution Times

Number of Scenarios	Average Execution Time (CPU Seconds) MOBILE4	MOBILE3	Ratio (M4/M3)	Average Time per Scenario (CPU Seconds) MOBILE4	MOBILE3
1	0.089	0.068	1.31	0.089	0.068
2	0.162	0.123	1.32	0.081	0.062
10	0.756	0.565	1.34	0.076	0.057
20	1.495	1.115	1.34	0.075	0.056
50	3.693	2.760	1.34	0.074	0.055
250	18.546	13.751	1.35	0.074	0.055

The MOBILE4 flag settings used for these execution timing runs are identical to those of Example 1 in Chapter 5. To the extent possible, the same or equivalent settings were used for the MOBILE3 runs (the considerable changes between MOBILE3 and MOBILE4 prevent direct comparison of precisely the same scenarios). The second scenario of Example 1 (CY of evaluation 1988) was executed the indicated number of times. These estimates were results from runs executed on an Amdahl 5890-180E computer. The average time per scenario statistic equals total execution time divided by the number of scenarios.

4.4 DEVIATIONS FROM FORTRAN STANDARD ANSI X3.9-1978

The previous version of the emission factor model, MOBILE3, was based on the FORTRAN language standard ANSI X3.9-1966 published by the American National Standards Institute. However, there were a number of incompatibilities between the FORTRAN code used in MOBILE3 and the ANSI X3.9-1966 standards. MOBILE4 has been updated to reflect the ANSI X3.9-1978 FORTRAN standards, and no incompatibilities are known to exist between the MOBILE4 code and that standard.

4.5 TYPICAL JOB STRUCTURE

Since job control language (JCL) is highly system-dependent, this manual does not provide examples. The general requirements for running a job are outlined here. Most users should have little difficulty implementing JCL to perform similar functions.

The simplest job structure for most systems is shown below:

```
JCL to sign on the computer system
JCL to compile MOBILE4 FORTRAN source code
                  .
                  .
                  .
     (MOBILE4 FORTRAN source code)
                  .
                  .
                  .
JCL to assign MOBILE4 I/O, catalog (link edit), and run MOBILE4
                  .
                  .
                  .
     (MOBILE4 input data)
                  .
                  .
                  .
```

MOBILE4 uses I/O device numbers stored in common IOUCOM. MOBILE4 I/O device assignments are:

4 = user-supplied inspection/maintenance (I/M) credits (IOUIMD)
5 = general input data (IOUGEN)
6 = formatted reports (IOUREP)
6 = diagnostic messages (IOUERR)
6 = input prompting messages (IOUASK)

Users can change these device numbers by modifying source code data statements initializing common IOUCOM in Block Data Subprogram 16. Output devices only can also be changed by assigning replacement numbers to IOUNEW on line 1 of the Control data section, as disucussed in section 2.1.2.

The job structure illustrated above does not read user-supplied I/M credits. Users can read I/M credits by entering the data from another I/O device, such as a disk file or magnetic tape. Alternately, users can merge the credits or rates with other input and change the I/M logical I/O device number from 4 to 5 by revising BLOCK DATA Subprogram 16 (line 516076);

```
change          DATA IOUIMD,IOUGEN,IOUERR,IOUASK/4,5,6,2*9/
to              DATA IOUIMD,IOUGEN,IOUERR,IOUASK/5,5,6,2*9/.
```

Another useful change (especially for OUTFMT = 1 or 2) might alter IOUREP from 6 to some other unused unit number via IOUNEW. Again, see section 2.1.2.

4.6 INSTALLATION, COMPILING, AND EXECUTION OF MOBILE4 ON PERSONAL COMPUTER SYSTEMS

4.6.1 Introduction

Due to the increased utilization of personal computers (PCs) by many parties involved in emission factor modeling and air quality planning functions, EPA has developed MOBILE4 so as to be compatible to the greatest extent possible with the two most commonly used PC systems: Apple MacIntosh, and IBM PC-AT (and its clones). However, since the development of the program was performed entirely on mainframe time-sharing systems, some differences exist between the MOBILE4 program as developed and discussed in this User's Guide, and the program in a form that can be executed on PC systems. This section provides instructions for installing, compiling, and executing MOBILE4 on the PCs mentioned.

4.6.2 Installing, Compiling, and Executing MOBILE4 on an Apple MacIntosh PC

The directions provided in this section assume that the MacIntosh being used has 512K bytes of free memory, a hard disk drive, and ABSOFT Corporation's MacFORTRAN or MacFORTRAN/020 compiler.

The first operation necessary is to port the MOBILE4 source code to the MacIntosh unit. To accomplish this transfer, an error-checking protocol (such as KERMIT) should be used. The MOBILE4 code should be transmitted so that an ASCII text file, with no hidden characters (such as tabs), is created.

Once transferred, the code must be modified slightly to accomodate the MacIntosh FORTRAN environment. These required modifications include file opening statements and screen/keyboard connections:

1. Insert the following lines controlling file I/O just before the statement **INERR=0** (line 1176) in the MOBILE4 **MAIN** program section:

```
OPEN(5,FILE='M4INPUT',STATUS='OLD')
OPEN(6,FILE='M4OUTPUT',STATUS='NEW')
```

2. If alternate I/M credits are also to be read in (see section 2.2.5), then insert the following line immediately after the statement **IF(NONUDA.EQ.2) GOTO 60** (line 115037) in Subroutine **GETIMC**:

```
OPEN(4,FILE='M4IMC',STATUS=OLD)
```

3. Finally, alter the initialization line for screen/keyboard I/O in **BLOCK DATA Subprogram 16** (line 516076) to read:

```
DATA IOUIMD,IOUGEN,IOUERR,IOUASK/4,5,6,2*9/
```

These changes direct MOBILE4 to always read the program input from a file called M4INPUT, and to always write the program output to a file called M4OUTPUT. Similarly, if the alternate I/M credit data modification was made, then the alternate credits will always be read from a file called M4IMC. Lastly, the initialization change directs all prompting or diagnostic messages to the MacIntosh screen (logical I/O device unit 9).

After these changes have been made, invoke the compiler. If your MacIntosh unit has a math coprocessor, select it using the OPTIONS menu.

When the compilation has been completed, the heap space for the resulting MOBILE4 application must be adjusted. To do this, click on the MOBILE4 application icon one time, then select the FILE option from the MacIntosh FINDER menu (not the compiler's menu). Highlight the GET INFO item, and note the application size value in the lower right portion of the window. If it is less than 512K, increase it to 512K. The MOBILE4 application is now ready for use.

Before running the program, place the MOBILE4 input stream (see Chapter 2) in a file called M4INPUT. Next, check to be sure that the M4OUTPUT file is empty. (If M4OUTPUT contains data or information you wish to save, simply rename it so that it is not overwritten by the results of the pending MOBILE4 run.) To execute, launch the MOBILE4 application by double-clicking its icon.

4.6.3 Installing, Compiling, and Executing MOBILE4 on an IBM PC-AT (or clone)

Due to the size of the MOBILE4 source code and the number of variables, common blocks, and other data structures contained in the program, the MOBILE4 code cannot be ported to these systems as easily as described above. While porting of the code to IBM PC-ATs (or clones) is possible, it is a more complicated procedure. For assistance in performing this operation, please contact EPA (see page -iv- at the front of this manual).

4.7 PROGRAM UPDATE INFORMATION

EPA expects MOBILE4 to undergo future revision to correct possible errors, improve program performance, and incorporate changes in the methodology. Users who wish to submit changes or corrections can mail these to the EPA Motor Vehicle Emission Laboratory in Ann Arbor, at the address given at the end of this section.

A list of program errors and User's Guide corrections will be compiled, if necessary, and distributed to EPA Regional Offices. EPA does not currently intend to support a user mailing list for automatic distribution of these corrections. Users should contact their Regional Offices from time to time. Users who wish to do so may submit the following Update Request form. In the event a complete mailing list is assembled, they will be included and sent any published changes to MOBILE4.

MOBILE4 UPDATE REQUEST

Mail to: MOBILE4 Emission Factor Project
U. S. EPA Motor Vehicle Emission Laboratory
Emission Control Technology Division
Test and Evaluation Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

Name and Address of User:

____

____

____

____

CITY ____________________ STATE __________

ZIP _____________________________________

Name(s) and telephone number(s) of individual(s) we may need to reach to respond to questions:

____

____

____

____

____

MOBILE4-1

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MOBILE4 UPDATE REQUEST

Mail to:

MOBILE4 Emission Factor Project
U. S. EPA Motor Vehicle Emission Laboratory
Emission Control Technology Division
Test and Evaluation Branch
2565 Plymouth Road
Ann Arbor, Michigan 48105

Name and Address of User:

____

____

____

____

CITY __________________________ STATE ________

ZIP ____

Name(s) and telephone number(s) of individual(s) we may need to reach to respond to questions:

____

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____

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Chapter 5

MOBILE4 EXAMPLES

5.0 INTRODUCTION

Four examples are provided to illustrate various aspects of MOBILE4. The user is encouraged to try two or more of these examples to ensure that the model as compiled is running properly.

5.1 EXAMPLES

The MOBILE4 examples are summarized in Table 5.1-1.

Table 5.1-1

Summary Description of MOBILE4 Examples

Example	Title	Content
1	Basic Run	Basic fleet emission rates evaluated on 1/1/80, 1/1/88, 1/1/90, and 1/1/00.
1a		OUTFMT = 1 (221-column numeric)
1b		OUTFMT = 2 (140-column numeric)
1c		OUTFMT = 3 (112-column descriptive)
1d		OUTFMT = 4 (80-column descriptive)
2	In-use Fuel Volatility and Onboard VRS Controls	Fleet emission rates, with in-use fuel volatility control (to 9.0 psi RVP in ASTM Class C areas) beginning in 1990, and onboard VRS refueling emission control beginning in MY 1993; evaluated on 1/1/80, 1/1/88, 1/1/90, and 1/1/00.
3	I/M + ATP	Fleet emission rates with an I/M program implemented on 1/1/83 and an ATP implemented on 1/1/86, evaluated on 1/1/79, 1/1/80, 1/1/88, 1/1/90, 1/1/00, and 1/1/20.
4	Replacement of MOBILE4 Data	Fleet emission rates with user-supplied annual mileage accumulation rates and vehicle registration distributions by age, evaluated on 1/1/80, 1/1/88, and 1/1/00.

5.1.1 Basic Run Example

This example is a basic MOBILE4 run, which reflects "national average" emission rates without inspection and maintenance (I/M) or anti-tampering programs (ATP). The user should note that each scenario output section includes information on whether I/M or an ATP has been included, and other information such as temperature and operating mode percentages.

Note that the input files contain identifying information to the right of the last columns that will be read by the program. This is useful in examination of the input files, and can prove very helpful in the tracking and correction of any input data errors that may occur.

This example is presented four times, once using each of the four output formats. This is done only to provide the reader with illustrations of the possible output formats. Note that the 221- and 140-column numeric outputs (OUTFMT = 1 or 2) are "wrapped around" in order to fit it on the page. These output formats are generally not used when hard copies are desired. (See section 3.3.1 for discussion of carraige control characters, which explains why the printed examples 1a and 1b are 220 and 139 columns, respectively, rather than 221 and 140.)

```
1          PROMPT - vertical flag input, no prompting
MOBILE4 Example 1a: OUTFMT = 1 (long (220 column) numeric output format)
1          TAMFLG - default tampering rates
1          SPDFLG - one speed per scenario for all IV
1          VMFLAG - default vmt mix
1          MYMRFG - default registration and mileage accrual rates
1          NEWFLG - default exhaust emission rates
1          IMFLAG - no I/M program
1          ALHFLG - no additional correction factor inputs
1          ATPFLG - no anti-tampering program
1          RLFLAG - no refueling losses
1          LOCFLG - read in local area parameters as 2nd req sc rec
1          TEMFLG - calculate exhaust temperatures
1          OUTFMT - long 220 column numeric output format
4          PRTFLG - print exhaust HC, CO and NOx emission factor results
1          IDLFLG - do not print idle emissions results
2          NMHFLG - print NMHC
2          HCFLAG - print HC components
1 80 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

```
MOBILE4 Example 1a: OUTFMT = 1 (long (220 column) numeric output format)
                                                                          P
R                                                                   Alt.  o
e                                            Amb.                         
g CY            Vehicle Speeds               Tmp  Cold/Hot Start  in Ft.  l   LDGV    LDGT1   LDGT2
- -- --------------------------------------- ---  ---------------- ------ - ------------------------
1 80 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 1   8.967   9.309  13.664
                                                                          X   4.294   4.782   6.964
                                                                          V   2.357   2.128   4.013
                                                                          R   0.410   0.484   0.482
                                                                          T   1.906   1.914   2.204
1 80 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 2  56.881  62.064  75.778
1 80 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 3   3.052   3.307   4.614
1 90 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 1   4.387   4.644   5.168
                                                                          X   1.942   2.668   2.785
                                                                          V   0.917   0.875   1.270
                                                                          R   0.283   0.350   0.348
                                                                          T   1.245   0.750   0.765
1 90 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 2  25.952  34.854  35.591
1 90 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 3   1.586   1.974   2.089
1  0 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 1   2.974   3.041   3.111
                                                                          X   1.059   1.626   1.699
                                                                          V   0.581   0.568   0.552
                                                                          R   0.247   0.326   0.326
                                                                          T   1.087   0.521   0.534
1  0 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 2  16.143  22.849  23.817
1  0 19.6/19.6/19.6/19.6/19.6/19.6/19.6/19.6  78  20.6  27.3  20.6   500. 3   1.068   1.477   1.469

                                                                                Vehicle Mix
  Composite Emission Factors
   LDGT     HDGV      LDDV      LDDT      HDDV        MC   All Veh  LDGV LDGT1 LDGT2  HDGV  LDDV  LDDT  HDDV    MC Scenario Title
------------------------------------------------------------------ ------------------------------------------------ ------------------
 11.037   20.121     0.609     0.945     4.916     8.600     9.334 0.708 0.129 0.085 0.015 0.006 0.001 0.045 0.010 Ann Arbor        MI
  5.648   10.159     0.609     0.945     4.916     6.566     4.697
  2.876    6.779                                   2.034     2.409
  0.484    0.821                                             0.407
  2.029    2.362                                             1.821
 67.504  186.457     1.503     2.119    15.553    33.627    58.632 0.708 0.129 0.085 0.015 0.006 0.001 0.045 0.010 Ann Arbor        MI
  3.826    6.750     1.499     1.949    28.912     0.470     4.396 0.708 0.129 0.085 0.015 0.006 0.001 0.045 0.010 Ann Arbor        MI
  4.855    8.854     0.600     0.723     2.513     4.908     4.430 0.710 0.127 0.086 0.015 0.013 0.004 0.034 0.010 Ann Arbor        MI
  2.715    3.478     0.600     0.723     2.513     2.331     2.130
  1.034    2.975                                   2.577     0.943
  0.349    0.604                                             0.284
  0.757    1.797                                             1.072
 35.151   69.840     1.564     1.672    12.289    21.953    27.650 0.710 0.127 0.086 0.015 0.013 0.004 0.034 0.010 Ann Arbor        MI
  2.020    5.422     1.447     1.546    18.531     0.821     2.306 0.710 0.127 0.086 0.015 0.013 0.004 0.034 0.010 Ann Arbor        MI
  3.071    6.300     0.461     0.633     2.051     4.449     2.904 0.693 0.116 0.085 0.015 0.035 0.017 0.029 0.010 Ann Arbor        MI
  1.657    2.418     0.461     0.633     2.051     1.859     1.208
  0.561    1.700                                   2.590     0.567
  0.326    0.539                                             0.245
  0.526    1.643                                             0.884
 23.258   37.435     1.392     1.550    10.881    21.437    17.028 0.693 0.116 0.085 0.015 0.035 0.017 0.029 0.010 Ann Arbor        MI
  1.474    4.301     1.068     1.205     8.723     0.830     1.418 0.693 0.116 0.085 0.015 0.035 0.017 0.029 0.010 Ann Arbor        MI
```

```
1          PROMPT - vertical flag input, no prompting
MOBILE4 Example 1b: OUTFMT = 2 (short (139 column) numeric output format)
1          TAMFLG - default tampering rates
1          SPDFLG - one speed per scenario for all IV
1          VMFLAG - default vmt mix
1          MYMRFG - default registration and mileage accrual rates
1          NEWFLG - default exhaust emission rates
1          IMFLAG - no I/M program
1          ALHFLG - no additional correction factor inputs
1          ATPFLG - no anti-tampering program
1          RLFLAG - no refueling losses
1          LOCFLG - read in local area parameters as 2nd req sc rec
1          TEMFLG - calculate exhaust temperatures
2          OUTFMT - short 139 column numeric output format
4          PRTFLG - print exhaust HC, CO and NOx emission factor results
1          IDLFLG - do not print idle emissions results
2          NMHFLG - print NMHC
2          HCFLAG - print HC components
1 80 19.6 75.0 20.6 27.3 20.6                 1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20   LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                 1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20   LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                 1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20   LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

```
MOBILE4 Example 1b: OUTFMT = 2 (short (139 column) numeric output format)

R                               P
e    Amb.                       o                              Composite Emission Factors
g CV Tmp   Cold/Hot Start       l  LDGV    LDGT1   LDGT2   LDGT    HDGV    LDDV    LDDT    HDDV     MC    AllVeh
- -- ----  -----------------    -  -----------------------------------------------------------------------------
1 80  78   20.6  27.3  20.6 1    8.97    9.31   13.66   11.04   20.12    0.61    0.95    4.92    8.60    9.33
                            X    4.29    4.78    6.96    5.65   10.16    0.61    0.95    4.92    6.57    4.70
                            V    2.36    2.13    4.01    2.88    6.78                            2.03    2.41
                            R    0.41    0.48    0.48    0.48    0.82                                    0.41
                            T    1.91    1.91    2.20    2.03    2.36                                    1.82
1 80  78   20.6  27.3  20.6 2   56.88   62.06   75.78   67.50  186.46    1.50    2.12   15.55   33.63   58.63
1 80  78   20.6  27.3  20.6 3    3.05    3.31    4.61    3.83    6.75    1.50    1.95   28.91    0.47    4.40
1 90  78   20.6  27.3  20.6 1    4.39    4.64    5.17    4.86    8.85    0.60    0.72    2.51    4.91    4.43
                            X    1.94    2.67    2.78    2.71    3.48    0.60    0.72    2.51    2.33    2.13
                            V    0.92    0.87    1.27    1.03    2.98                            2.58    0.94
                            R    0.28    0.35    0.35    0.35    0.60                                    0.28
                            T    1.25    0.75    0.77    0.76    1.80                                    1.07
1 90  78   20.6  27.3  20.6 2   25.95   34.85   35.59   35.15   69.84    1.56    1.67   12.29   21.95   27.65
1 90  78   20.6  27.3  20.6 3    1.59    1.97    2.09    2.02    5.42    1.45    1.55   18.53    0.82    2.31
1  0  78   20.6  27.3  20.6 1    2.97    3.04    3.11    3.07    6.30    0.46    0.63    2.05    4.45    2.90
                            X    1.06    1.63    1.70    1.66    2.42    0.46    0.63    2.05    1.86    1.21
                            V    0.58    0.57    0.55    0.56    1.70                            2.59    0.57
                            R    0.25    0.33    0.33    0.33    0.54                                    0.24
                            T    1.09    0.52    0.53    0.53    1.64                                    0.88
1  0  78   20.6  27.3  20.6 2   16.14   22.85   23.82   23.26   37.43    1.39    1.55   10.88   21.44   17.03
1  0  78   20.6  27.3  20.6 3    1.07    1.48    1.47    1.47    4.30    1.07    1.21    8.72    0.83    1.42

              Vehicle Mix
LDGV LDGT1LDGT2HDGV LDDV LDDT HDDV  MC
--------------------------------------
.708 .129 .085 .015 .006 .001 .045 .010
.708 .129 .085 .015 .006 .001 .045 .010
.708 .129 .085 .015 .006 .001 .045 .010
.710 .127 .086 .015 .013 .004 .034 .010
.710 .127 .086 .015 .013 .004 .034 .010
.710 .127 .086 .015 .013 .004 .034 .010
.693 .116 .085 .015 .035 .017 .029 .010
.693 .116 .085 .015 .035 .017 .029 .010
.693 .116 .085 .015 .035 .017 .029 .010
```

```
1           PROMPT - vertical flag input, no prompting
MOBILE4 Example 1c: OUTFMT = 3 (landscape (112 column) descriptive output format)
1           TAMFLG - default tampering rates
1           SPDFLG - one speed per scenario for all IV
1           VMFLAG - default vmt mix
1           MYMRFG - default registration and mileage accrual rates
1           NEWFLG - default exhaust emission rates
1           IMFLAG - no I/M program
1           ALHFLG - no additional correction factor inputs
1           ATPFLG - no anti-tampering program
1           RLFLAG - no refueling losses
1           LOCFLG - read in local area parameters as 2nd req sc rec
1           TEMFLG - calculate exhaust temperatures
3           OUTFMT - MOBILE4 112 column descriptive output format
4           PRTFLG - print exhaust HC, CO and NOx emission factor results
1           IDLFLG - do not print idle emissions results
2           NMHFLG - print NMHC
2           HCFLAG - print HC components
1 80 19.6 75.0 20.6 27.3 20.6                      1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor    MI C  60.  84. 11.5 11.5 20        LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                      1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor    MI C  60.  84. 11.5 11.5 20        LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                      1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor    MI C  60.  84. 11.5 11.5 20        LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

MOBILE4 Example 1c: OUTFMT = 3 (landscape (112 column) descriptive output format

Non-methane HC emission factors include evaporative HC emission factors.

```
-------------------------------------------------------------------------------------------------------------
Cal. Year: 1980        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI       ASTM Class: C          Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

     Veh. Type:       LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV      MC     All Veh
   Veh. Speeds:       19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
      VMT Mix:        0.708    0.129     0.085                0.015     0.006     0.001     0.045     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:          8.97      9.31     13.66     11.04     20.12      0.61      0.95      4.92      8.60     9.334
Exhaust  HC:          4.29      4.78      6.96      5.65     10.16      0.61      0.95      4.92      6.57     4.697
Evaporat HC:          2.36      2.13      4.01      2.88      6.78                                    2.03     2.409
Refuel L HC:          0.41      0.48      0.48      0.48      0.82                                             0.407
Runing L HC:          1.91      1.91      2.20      2.03      2.36                                             1.821
Exhaust  CO:         56.88     62.06     75.78     67.50    186.46      1.50      2.12     15.55     33.63    58.632
Exhaust NOX:          3.05      3.31      4.61      3.83      6.75      1.50      1.95     28.91      0.47     4.396
-------------------------------------------------------------------------------------------------------------
Cal. Year: 1990        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI       ASTM Class: C          Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

     Veh. Type:       LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV      MC     All Veh
   Veh. Speeds:       19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
      VMT Mix:        0.710    0.127     0.086                0.015     0.013     0.004     0.034     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:          4.39      4.64      5.17      4.86      8.85      0.60      0.72      2.51      4.91     4.430
Exhaust  HC:          1.94      2.67      2.78      2.71      3.48      0.60      0.72      2.51      2.33     2.130
Evaporat HC:          0.92      0.87      1.27      1.03      2.98                                    2.58     0.943
Refuel L HC:          0.28      0.35      0.35      0.35      0.60                                             0.284
Runing L HC:          1.25      0.75      0.77      0.76      1.80                                             1.072
Exhaust  CO:         25.95     34.85     35.59     35.15     69.84      1.56      1.67     12.29     21.95    27.650
Exhaust NOX:          1.59      1.97      2.09      2.02      5.42      1.45      1.55     18.53      0.82     2.306
-------------------------------------------------------------------------------------------------------------
Cal. Year: 2000        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI       ASTM Class: C          Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

     Veh. Type:       LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV      MC     All Veh
   Veh. Speeds:       19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
      VMT Mix:        0.693    0.116     0.085                0.015     0.035     0.017     0.029     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:          2.97      3.04      3.11      3.07      6.30      0.46      0.63      2.05      4.45     2.904
Exhaust  HC:          1.06      1.63      1.70      1.66      2.42      0.46      0.63      2.05      1.86     1.208
Evaporat HC:          0.58      0.57      0.55      0.56      1.70                                    2.59     0.567
```

Refuel L HC:	0.25	0.33	0.33	0.33	0.54					0.245
Runing L HC:	1.09	0.52	0.53	0.53	1.64					0.884
Exhaust CO:	16.14	22.85	23.82	23.26	37.43	1.39	1.55	10.88	21.44	17.028
Exhaust NOX:	1.07	1.48	1.47	1.47	4.30	1.07	1.21	8.72	0.83	1.418

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```
1           PROMPT - vertical flag input, no prompting
MOBILE4 Example 1d: OUTFMT = 4 (portrait (80 column) descriptive output format)
1           TAMFLG - default tampering rates
1           SPDFLG - one speed per scenario for all IV
1           VMFLAG - default vmt mix
1           MYMRFG - default registration and mileage accrual rates
1           NEWFLG - default exhaust emission rates
1           IMFLAG - no I/M program
1           ALHFLG - no additional correction factor inputs
1           ATPFLG - no anti-tampering program
1           RLFLAG - no refueling losses
1           LOCFLG - read in local area parameters as 2nd req sc rec
1           TEMFLG - calculate exhaust temperatures
4           OUTFMT - portrait 80 column descriptive output format
4           PRTFLG - print exhaust HC, CO and NOx emission factor results
1           IDLFLG - do not print idle emissions results
2           NMHFLG - print NMHC
2           HCFLAG - print HC components
1 80 19.6 75.0 20.6 27.3 20.6                        1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20         LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                        1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20         LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                        1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C 60.  84. 11.5 11.5 20         LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

```
MOBILE4 Example 1d: OUTFMT = 4 (portrait (80 column) descriptive output format)

Non-methane HC emission factors include evaporative HC emission factors.

---------------------------------------------------------------------------

Cal. Year: 1980          Region: Low         Altitude:  500. Ft.
                    I/M Program: No      Ambient Temp:   78.1 / 78.1 / 78.1 F
                Anti-tam. Program: No    Operating Mode:   20.6 / 27.3 / 20.6

Ann Arbor    MI       ASTM Class: C
                    Minimum Temp: 60. (F)   Maximum Temp: 84. (F)
                        Base RVP: 11.5   In-use (IU) RVP: 11.5   IU 1st Yr: 2020

Veh. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC   All Veh
Veh. Spd.:  19.6    19.6    19.6            19.6    19.6    19.6    19.6   19.6
  VMT Mix:  0.708   0.129   0.085           0.015   0.006   0.001   0.045  0.010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  8.97    9.31   13.66   11.04   20.12    0.61    0.95    4.92   8.60    9.33
Exhst  HC:  4.29    4.78    6.96    5.65   10.16    0.61    0.95    4.92   6.57    4.70
Evap.  HC:  2.36    2.13    4.01    2.88    6.78                           2.03    2.41
Refuel HC:  0.41    0.48    0.48    0.48    0.82                                   0.41
Runing HC:  1.91    1.91    2.20    2.03    2.36                                   1.82
Exhst  CO: 56.88   62.06   75.78   67.50  186.46    1.50    2.12   15.55  33.63   58.63
Exhst NOX:  3.05    3.31    4.61    3.83    6.75    1.50    1.95   28.91   0.47    4.40
---------------------------------------------------------------------------
Cal. Year: 1990          Region: Low         Altitude:  500. Ft.
                    I/M Program: No      Ambient Temp:   78.1 / 78.1 / 78.1 F
                Anti-tam. Program: No    Operating Mode:   20.6 / 27.3 / 20.6

Ann Arbor    MI       ASTM Class: C
                    Minimum Temp: 60. (F)   Maximum Temp: 84. (F)
                        Base RVP: 11.5   In-use (IU) RVP: 11.5   IU 1st Yr: 2020

Veh. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC   All Veh
Veh. Spd.:  19.6    19.6    19.6            19.6    19.6    19.6    19.6   19.6
  VMT Mix:  0.710   0.127   0.086           0.015   0.013   0.004   0.034  0.010

Composite Emission Factors (Gm/Mile)
No-Mth HC:  4.39    4.64    5.17    4.86    8.85    0.60    0.72    2.51   4.91    4.43
Exhst  HC:  1.94    2.67    2.78    2.71    3.48    0.60    0.72    2.51   2.33    2.13
Evap.  HC:  0.92    0.87    1.27    1.03    2.98                           2.58    0.94
Refuel HC:  0.28    0.35    0.35    0.35    0.60                                   0.28
Runing HC:  1.25    0.75    0.77    0.76    1.80                                   1.07
Exhst  CO: 25.95   34.85   35.59   35.15   69.84    1.56    1.67   12.29  21.95   27.65
Exhst NOX:  1.59    1.97    2.09    2.02    5.42    1.45    1.55   18.53   0.82    2.31
---------------------------------------------------------------------------
Cal. Year: 2000          Region: Low         Altitude:  500. Ft.
                    I/M Program: No      Ambient Temp:   78.1 / 78.1 / 78.1 F
                Anti-tam. Program: No    Operating Mode:   20.6 / 27.3 / 20.6

Ann Arbor    MI       ASTM Class: C
                    Minimum Temp: 60. (F)   Maximum Temp: 84. (F)
                        Base RVP: 11.5   In-use (IU) RVP: 11.5   IU 1st Yr: 2020

Veh. Type:  LDGV   LDGT1   LDGT2    LDGT    HDGV    LDDV    LDDT    HDDV    MC   All Veh
Veh. Spd.:  19.6    19.6    19.6            19.6    19.6    19.6    19.6   19.6
```

```
  VMT Mix:   0.693  0.116  0.085         0.015  0.035  0.017  0.029  0.010

Composite Emission Factors (Gm/Mile)
No-Mth HC:   2.97   3.04   3.11   3.07   6.30   0.46   0.63   2.05   4.45   2.90
Exhst  HC:   1.06   1.63   1.70   1.66   2.42   0.46   0.63   2.05   1.86   1.21
Evap.  HC:   0.58   0.57   0.55   0.56   1.70                        2.59   0.57
Refuel HC:   0.25   0.33   0.33   0.33   0.54                               0.24
Runing HC:   1.09   0.52   0.53   0.53   1.64                               0.88
Exhst  CO:  16.14  22.85  23.82  23.26  37.43   1.39   1.55  10.88  21.44  17.03
Exhst NOX:   1.07   1.48   1.47   1.47   4.30   1.07   1.21   8.72   0.83   1.42
```

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5.1.2 In-Use Volatility Control and Onboard Refueling VRS Emission Control Requirements Example

This example illustrates the use of the options for modeling an in-use fuel volatility control requirement and an onboard refueling vapor recovery system (VRS) requirement. The in-use volatility control requirement information is contained in the local area parameter record, and reflects a program limiting in-use volatility to 9.0 psi RVP in ASTM Class C areas beginning in 1990 (see section 2.2.13). The onboard VRS descriptive input record is included in the One-time data section, and reflects a requirement that all gasoline-fueled vehicles except motorcycles (LDGVs, LDGT1s, LDGT2s, and HDGVs) be equipped with onboard systems beginning in the 1993 model year (see section 2.2.7).

Note that the parameters of the in-use volatility control program are reflected in the echoing of the local area parameter record, with the base RVP applying to all years of evaluation up to and including 1989, and the in-use (controlled) RVP applying to 1990 and later evaluation years. The onboard requirement is not reflected in the "echoed" portion of the output, but is clearly seen in the much lower refueling component HC emission factors in the last year of evaluation.

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```
1          PROMPT - vertical flag input, no prompting
MOBILE4 Example 2: RLFLAG = 3 (volatility and onboard control)
1          TAMFLG - default tampering rates
1          SPDFLG - one speed per scenario for all IV
1          VMFLAG - default vmt mix
1          MVMRFG - default registration and mileage accrual rates
1          NEWFLG - default exhaust emission rates
1          IMFLAG - no I/M program
1          ALHFLG - no additional correction factor inputs
1          ATPFLG - no anti-tampering program
3          RLFLAG - refueling losses
1          LOCFLG - read in local area parameters as 2nd req sc rec
1          TEMFLG - calculate exhaust temperatures
3          OUTFMT - MOBILE4 112 column descriptive output format
4          PRTFLG - print exhaust HC, CO and NOx emission factor results
1          IDLFLG - do not print idle emissions results
2          NMHFLG - print NMHC
2          HCFLAG - print HC components
93 2222       IOBMY, IVOB
1 80 19.6 75.0 20.6 27.3 20.6               1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5  9.0 90     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
1 90 19.6 75.0 20.6 27.3 20.6               1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5  9.0 90     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
1 00 19.6 75.0 20.6 27.3 20.6               1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5  9.0 90     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESV
```

MOBILE4 Example 2: RLFLAG = 3 (volatility and onboard control)

Non-methane HC emission factors include evaporative HC emission factors.

```
------------------------------------------------------------------------------------------------------------
Cal. Year: 1980         I/M Program: No        Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: No      Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI         ASTM Class: C        Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5         In-use RVP:  9.0   In-use Start Yr: 1990

   Veh. Type:        LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV       MC     All Veh
 Veh. Speeds:        19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
     VMT Mix:        0.708    0.129     0.085                0.015     0.006     0.001     0.045     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:         8.97      9.31     13.66     11.04     20.12      0.61      0.95      4.92      8.60     9.334
Exhaust  HC:         4.29      4.78      6.96      5.65     10.16      0.61      0.95      4.92      6.57     4.697
Evaporat HC:         2.36      2.13      4.01      2.88      6.78                                    2.03     2.409
Refuel L HC:         0.41      0.48      0.48      0.48      0.82                                             0.407
Runing L HC:         1.91      1.91      2.20      2.03      2.36                                             1.821
Exhaust  CO:        56.88     62.06     75.78     67.50    186.46      1.50      2.12     15.55     33.63    58.632
Exhaust NOX:         3.05      3.31      4.61      3.83      6.75      1.50      1.95     28.91      0.47     4.396
------------------------------------------------------------------------------------------------------------
Cal. Year: 1990         I/M Program: No        Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: No      Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI         ASTM Class: C        Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5         In-use RVP:  9.0   In-use Start Yr: 1990

   Veh. Type:        LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV       MC     All Veh
 Veh. Speeds:        19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
     VMT Mix:        0.710    0.127     0.086                0.015     0.013     0.004     0.034     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:         2.87      3.38      3.76      3.53      6.17      0.60      0.72      2.51      3.92     3.023
Exhaust  HC:         1.76      2.38      2.52      2.44      3.36      0.60      0.72      2.51      2.33     1.941
Evaporat HC:         0.52      0.49      0.74      0.59      1.76                                    1.59     0.540
Refuel L HC:         0.22      0.28      0.28      0.28      0.48                                             0.226
Runing L HC:         0.36      0.23      0.22      0.22      0.58                                             0.315
Exhaust  CO:        21.57     28.29     29.40     28.74     63.81      1.56      1.67     12.29     21.95    23.082
Exhaust NOX:         1.58      1.98      2.09      2.02      5.74      1.45      1.55     18.53      0.82     2.304
------------------------------------------------------------------------------------------------------------
Cal. Year: 2000         I/M Program: No        Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: No      Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor      MI         ASTM Class: C        Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5         In-use RVP:  9.0   In-use Start Yr: 1990

   Veh. Type:        LDGV     LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV       MC     All Veh
 Veh. Speeds:        19.6     19.6      19.6                 19.6      19.6      19.6      19.6      19.6
     VMT Mix:        0.693    0.116     0.085                0.015     0.035     0.017     0.029     0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:         1.48      1.78      1.83      1.80      3.77      0.46      0.63      2.05      3.46     1.568
Exhaust  HC:         0.84      1.27      1.32      1.29      2.21      0.46      0.63      2.05      1.86     0.981
Evaporat HC:         0.26      0.27      0.27      0.27      0.88                                    1.60     0.266
```

Refuel L HC:	0.08	0.10	0.09	0.09	0.13					0.076
Runing L HC:	0.30	0.15	0.15	0.15	0.55					0.245
Exhaust CO:	10.51	14.64	15.20	14.88	28.83	1.39	1.55	10.88	21.44	11.316
Exhaust NOX:	1.04	1.44	1.43	1.43	4.67	1.07	1.21	8.72	0.83	1.394

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5.1.3 I/M and ATP Example

This example illustrates the use of a control file which estimates the impact of an I/M program and an anti-tampering program (ATP). The I/M and ATP program characteristics are summarized at the top of the run header. Note that the scenario output records are now echoing the fact that I/M and ATP are being accounted for in estimating emission rates. Also note that no ATP emission credit matrices are required as program input, since MOBILE4 now calculates the required matrices internally on the basis of the ATP characteristics specified by the user on the ATP descriptive input record.

Note that the warning messages M108, M109, and M110 are printed after the project title. This reflects the discrepancies in the I/M program and ATP parameters specified in this example. As noted in section 3.2, I/M programs and ATPs are generally operated together in any given area, and so generally would have the same compliance rates, inspection frequencies, and inspection types.

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```
1          PROMPT - vertical flag input, no prompting
MOBILE4 Example 3: ATPFLG = 2 (Anti-tampering Program), LAPSY = 1986, ICVIM = 1983
1          TAMFLG - default tampering rates
1          SPDFLG - one speed per scenario for all IV
1          VMFLAG - default vmt mix
1          MYMRFG - default registration and mileage accrual rates
1          NEWFLG - default exhaust emission rates
2          IMFLAG - I/M program
1          ALHFLG - no additional correction factor inputs
2          ATPFLG - anti-tampering program
1          RLFLAG - no refueling losses
1          LOCFLG - read in local area parameters as 2nd req sc rec
1          TEMFLG - calculate exhaust temperatures
3          OUTFMT - MOBILE4 112 column descriptive output format
4          PRTFLG - print exhaust HC, CO and NOx emission factor results
1          IDLFLG - do not print idle emissions results
2          NMHFLG - print NMHC
1          HCFLAG - do ont print HC components
83 30 68 20 20 10 070 2 2 2221 2 11   ICVIM,ISTRIN,MODVR1/2,WAIVER(1-2),CRIM,INTYP,IFREQ,ILDT(1-4),ITEST,NUDATA(1-2)
86 75 20 2111 11 090. 22211221        ATP parameters: start, 1st myr, last myr, veh types, insp pgm type & freq, compliance, disable
1 79 19.6 75.0 20.6 27.3 20.6                       1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C  60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 80 19.6 75.0 20.6 27.3 20.6                       1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C  60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                       1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C  60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                       1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C  60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 20 19.6 75.0 20.6 27.3 20.6                       1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor      MI C  60.  84. 11.5 11.5 20      LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

```
MOBILE4 Example 3: ATPFLG = 2 (Anti-tampering Program), LAPSY = 1986, ICVIM = 19


M108 Warning:  The ATP compliance rate of  90.0 is not  equal to the I/M compliance rate of  70.0

M109 Warning:  The ATP inspection frequency is Annual   and the I/M inspection frequency is Biennial

M110 Warning:  The ATP inspection type is Central  the I/M inspection type is Dec Comp

I/M program selected:

    Start year (January 1):              1983
    Pre-1981 MVR stringency rate:         30%
    First model year covered:            1968
    Last model year covered:             2020
    Waiver rate (pre-1981):              20.%
    Waiver rate (1981 and newer):        10.%
    Compliance Rate:                     70.%
    Inspection type:                     Computerized decentralized
    Inspection frequency                 Biennial
    Vehicle types covered:               LDGV - Yes
                                        LDGT1 - Yes
                                        LDGT2 - Yes
                                         HDGV - No
    1981 & later MVR test type:          2500 rpm / Idle

Anti-tampering program selected:

    Start year (January 1):              1986
    First model year covered:            1975
    Last model year covered:             2020
    Vehicle types covered:               LDGV

    Type:                                Centralized
    Frequency:                           Annual
    Compliance Rate:                     90.0%

    Air pump system disablements:        Yes
    Catalyst removals:                   Yes
    Fuel inlet restrictor disablements:  Yes
    Tailpipe lead deposit test:          No
    EGR disablement:                     No
    Evaporative system disablements:     Yes
    PCV system disablements:             Yes
    Missing gas caps:                    No

Non-methane HC emission factors include evaporative HC emission factors.
```

```
Cal. Year: 1979        I/M Program: Yes      Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: Yes    Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor    MI         ASTM Class: C         Minimum Temp:  60. (F)        Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5   In-use Start Yr: 2020
```

```
 Veh. Type:       LDGV     LDGT1    LDGT2     LDGT     HDGV     LDDV     LDDT     HDDV      MC     All Veh
Veh. Speeds:      19.6     19.6     19.6               19.6     19.6     19.6     19.6     19.6
    VMT Mix:      0.711    0.130    0.085              0.015    0.003    0.000    0.045    0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       9.48     9.75    14.98    11.82    21.55     0.76     0.92     5.07     9.55     9.942
Exhaust  CO:      59.53    64.85    82.11    71.69   208.89     1.73     2.08    14.91    35.33    61.960
Exhaust NOX:       3.14     3.44     5.02     4.07     6.91     1.53     1.92    29.46     0.39     4.546
-----------------------------------------------------------------------------------------------------------

Cal. Year: 1980        I/M Program: Yes      Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: Yes    Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI        ASTM Class: C         Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

 Veh. Type:       LDGV     LDGT1    LDGT2     LDGT     HDGV     LDDV     LDDT     HDDV      MC     All Veh
Veh. Speeds:      19.6     19.6     19.6               19.6     19.6     19.6     19.6     19.6
    VMT Mix:      0.708    0.129    0.085              0.015    0.006    0.001    0.045    0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       8.97     9.31    13.66    11.04    20.12     0.61     0.95     4.92     8.60     9.334
Exhaust  CO:      56.88    62.06    75.78    67.50   186.46     1.50     2.12    15.55    33.63    58.632
Exhaust NOX:       3.05     3.31     4.61     3.83     6.75     1.50     1.95    28.91     0.47     4.396
-----------------------------------------------------------------------------------------------------------

Cal. Year: 1990        I/M Program: Yes      Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: Yes    Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI        ASTM Class: C         Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

 Veh. Type:       LDGV     LDGT1    LDGT2     LDGT     HDGV     LDDV     LDDT     HDDV      MC     All Veh
Veh. Speeds:      19.6     19.6     19.6               19.6     19.6     19.6     19.6     19.6
    VMT Mix:      0.710    0.127    0.086              0.015    0.013    0.004    0.034    0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       3.88     4.25     4.81     4.48     8.85     0.60     0.72     2.51     4.91     3.992
Exhaust  CO:      20.28    29.49    29.81    29.62    69.84     1.56     1.67    12.29    21.95    22.445
Exhaust NOX:       1.54     1.84     1.96     1.89     5.42     1.45     1.55    18.53     0.82     2.245
-----------------------------------------------------------------------------------------------------------

Cal. Year: 2000        I/M Program: Yes      Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: Yes    Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI        ASTM Class: C         Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5    In-use Start Yr: 2020

 Veh. Type:       LDGV     LDGT1    LDGT2     LDGT     HDGV     LDDV     LDDT     HDDV      MC     All Veh
Veh. Speeds:      19.6     19.6     19.6               19.6     19.6     19.6     19.6     19.6
    VMT Mix:      0.693    0.116    0.085              0.015    0.035    0.017    0.029    0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       2.55     2.70     2.76     2.73     6.30     0.46     0.63     2.05     4.45     2.544
Exhaust  CO:      12.42    19.08    19.91    19.43    37.43     1.39     1.55    10.88    21.44    13.682
Exhaust NOX:       0.97     1.36     1.35     1.36     4.30     1.07     1.21     8.72     0.83     1.327
-----------------------------------------------------------------------------------------------------------

Cal. Year: 2020        I/M Program: Yes      Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                   Anti-tam. Program: Yes    Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.
```

```
Ann Arbor     MI         ASTM Class: C         Minimum Temp:  60. (F)          Maximum Temp:  84. (F)
   Base RVP: 11.5        In-use RVP: 11.5   In-use Start Yr: 2020

   Veh. Type:        LDGV      LDGT1      LDGT2       LDGT       HDGV       LDDV       LDDT       HDDV        MC      All Veh
Veh. Speeds:         19.6      19.6       19.6                   19.6       19.6       19.6       19.6       19.6
    VMT Mix:        0.684     0.112      0.086                  0.015      0.043      0.021      0.029      0.010

Composite Emission Factors (Gm/Mile)
Non-Meth HC:         2.52      2.58       2.65       2.61       6.03       0.50       0.68       2.03       4.45      2.470
Exhaust  CO:        12.01     18.05      18.98      18.46      34.03       1.45       1.60      10.78      21.44     13.006
Exhaust NOX:         0.95      1.30       1.30       1.30       4.19       1.10       1.23       8.05       0.83      1.283
```

5.1.4 Replacement of MOBILE4 Data Example

This example illustrates the use of alternate locality-specific data for the MOBILE4 annual mileage accumulation rates and the vehicle registration distributions by age. Note that the input files containing the annual mileage accumulation rates and the vehicle registration distributions by age also include identifying information to the right of the last columns that will be read by the program. This is advisable for future reference, and may assist the user in tracking and correcting of any data input errors. EPA recommends that similar identfying information be included in the input files used for SIP-related MOBILE4 runs.

Also note the warning messages that follow the project title. M 49 is printed six times, once for each vehicle type for which the input registration distribution by does not sum to 1.0. In this example, the registration distributions by age for LDGVs and LDDVs each sum to 0.999 (and are equal by year, as required); and the registration distributions by age for LDGT1s, LDDTs, and HDDVs each sum to 0.992 (with the distributions for LDGT1s and LDDTs equal by year, as required). The registration distribution by age summed to 1.001 for motorcycles, resulting in the last printing of M 49. Values of 1.000 ± 0.003 for the sum of user-supplied registration distributions by age are generally the result of rounding, and are no cause for concern. Note also that message M 21 is printed twice, since motorcycles of ages 12 and 13 were defined to exist in the registration distribution (as 0.5% and 1.3% of the motorcycle fleet, respectively), but had no annual mileage accumulation rate assigned. See sections 2.2.3 and 3.2.

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```
1          PROMPT - vertical flag input, no prompting
MOBILE4 Example 4: MYMRFG = 4 (New mileage accrual rates & registration distributions)
1          TAMFLG - default tampering rates
1          SPDFLG - one speed per scenario for all IV
1          VMFLAG - default vmt mix
4          MYMRFG - new registration and mileage accrual rates
1          NEWFLG - default exhaust emission rates
1          IMFLAG - no I/M program
1          ALHFLG - no additional correction factor inputs
1          ATPFLG - no anti-tampering program
1          RLFLAG - no refueling losses
1          LOCFLG - read in local area parameters as 2nd req sc rec
1          TEMFLG - calculate exhaust temperatures
3          OUTFMT - MOBILE4 112 column descriptive output format
4          PRTFLG - print exhaust HC, CO and NOx emission factor results
1          IDLFLG - do not print idle emissions results
2          NMHFLG - print NMHC
1          HCFLAG - do ont print HC components
 .12800 .12100 .11400 .10800 .10200 .09600 .09100 .08600 .08100 .076                 AMAR.LDGV..my ages 1-10
 .07200 .06800 .06400 .06100 .05700 .05400 .05100 .04800 .04600 .043                    00 .LDGV..my ages 11-20
 .17400 .16100 .15000 .13900 .12900 .11900 .11100 .10300 .09500 .088                    00 .LDGT1.my ages 1-10
 .08200 .07600 .07000 .06500 .06100 .05600 .05200 .04800 .04500 .042                    00 .LDGT1.my ages 11-20
 .18400 .16900 .15600 .14400 .13300 .12300 .11400 .10500 .09700 .090                    00 .LDGT2.my ages 1-10
 .08300 .07600 .07100 .06500 .06000 .05600 .05100 .04700 .04400 .040                    00 .LDGT2.my ages 11-20
 .19900 .18100 .16400 .14800 .13400 .12100 .11000 .10000 .09000 .082                    00 .HDGV..my ages 1-10
 .07400 .06700 .06100 .05500 .05000 .04500 .04100 .03700 .03300 .030                    00 .HDGV..my ages 11-20
 .12800 .12100 .11400 .10800 .10200 .09600 .09100 .08600 .08100 .076                    00 .LDDV..my ages 1-10
 .07200 .06800 .06400 .06100 .05700 .05400 .05100 .04800 .04600 .043                    00 .LDDV..my ages 11-20
 .17500 .16300 .15100 .14000 .12900 .12000 .11100 .10300 .09500 .088                    00 .LDDT..my ages 1-10
 .08200 .07600 .07000 .06500 .06000 .05600 .05200 .04800 .04400 .041                    00 .LDDT..my ages 11-20
 .19900 .18100 .16400 .14800 .13400 .12100 .11000 .10000 .09000 .082                    00 .HDDV..my ages 1-10
 .07400 .06700 .06100 .05500 .05000 .04500 .04100 .03700 .03300 .030                    00 .HDDV..my ages 11-20
 .04100 .02800 .02100 .01600 .01200 .00800 .00600 .00400 .00200 .002                    00 .MC....my ages 1-10
 .00200 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .00000 .000                    00 .MC....my ages 11-20
 .075 .107 .107 .106 .100 .092 .085 .077 .066 .052               JULMVR.LDGV..my ages 1-10
 .039 .027 .018 .014 .009 .006 .005 .005 .005 .004                     .LDGV..my ages 11-20
 .061 .095 .094 .103 .083 .076 .076 .063 .054 .043                     .LDGT1.my ages 1-10
 .036 .024 .030 .028 .026 .024 .022 .020 .018 .016                     .LDGT1.my ages 11-20
 .037 .070 .078 .086 .075 .075 .075 .068 .059 .053                     .LDGT2.my ages 1-10
 .044 .032 .038 .036 .034 .032 .030 .028 .026 .024                     .LDGT2.my ages 11-20
 .037 .070 .078 .086 .075 .075 .075 .068 .059 .053                     .HDGV..my ages 1-10
 .044 .032 .038 .036 .034 .032 .030 .028 .026 .024                     .HDGV..my ages 11-20
 .075 .107 .107 .106 .100 .092 .085 .077 .066 .052                     .LDDV..my ages 1-10
 .039 .027 .018 .014 .009 .006 .005 .005 .005 .004                     .LDDV..my ages 11-20
 .061 .095 .094 .103 .083 .076 .076 .063 .054 .043                     .LDDT..my ages 1-10
 .036 .024 .030 .028 .026 .024 .022 .020 .018 .016                     .LDDT..my ages 11-20
 .077 .135 .134 .131 .099 .090 .082 .062 .045 .033                     .HDDV..my ages 1-10
 .025 .015 .013 .011 .010 .008 .007 .006 .005 .004                     .HDDV..my ages 11-20
 .105 .225 .206 .149 .097 .062 .046 .033 .029 .023                     .MC....my ages 1-10
 .008 .005 .013 .000 .000 .000 .000 .000 .000 .000                     .MC....my ages 11-20
1 80 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 90 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
1 00 19.6 75.0 20.6 27.3 20.6                     1st req sc rec: IREJN,ICY,SPD(1),AMBT,PCCN,PCHC,PCCC
Ann Arbor     MI C  60.  84. 11.5 11.5 20     LAP rec: SCNAME,RVPAST,TEMMIN,TEMMAX,RVPBAS,RVPIUS,IUSESY
```

```
MOBILE4 Example 4: MYMRFG = 4 (New mileage accrual rates & registration distributions)


M 49 Warning:  0.999     MVR sum not = 1. (will normalize)

M 49 Warning:  0.992     MVR sum not = 1. (will normalize)

M 49 Warning:  0.999     MVR sum not = 1. (will normalize)

M 49 Warning:  0.992     MVR sum not = 1. (will normalize)

M 49 Warning:  0.992     MVR sum not = 1. (will normalize)

M 49 Warning:   1.00     MVR sum not = 1. (will normalize)

M 21 Warning:  0.500E-02 registration with zero mileage

M 21 Warning:  0.130E-01 registration with zero mileage
Non-methane HC emission factors include evaporative HC emission factors.
------------------------------------------------------------------------------------------------------
User supplied  mileage accrual distributions, veh registration distributions.

Cal. Year: 1980        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI         ASTM Class: C        Minimum Temp:  60. (F)         Maximum Temp:  84. (F)
   Base RVP: 11.5        In-use RVP: 11.5   In-use Start Yr: 2020

   Veh. Type:      LDGV      LDGT1      LDGT2      LDGT       HDGV      LDDV      LDDT      HDDV      MC      All Veh
 Veh. Speeds:      19.6      19.6       19.6                  19.6      19.6      19.6      19.6      19.6
     VMT Mix:      0.740     0.139      0.083                 0.013     0.006     0.001     0.012     0.006

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       7.30      9.06      14.50      11.09      22.31      0.58      0.94      4.06      7.81     8.262
Exhaust  CO:      47.07     62.37      81.10      69.36     209.39      1.46      2.11     13.10     28.79    53.367
Exhaust NOX:       2.89      3.29       4.80       3.86       7.12      1.48      1.94     26.33      0.55     3.410
------------------------------------------------------------------------------------------------------
User supplied  mileage accrual distributions, veh registration distributions.

Cal. Year: 1990        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI         ASTM Class: C        Minimum Temp:  60. (F)         Maximum Temp:  84. (F)
   Base RVP: 11.5        In-use RVP: 11.5   In-use Start Yr: 2020

   Veh. Type:      LDGV      LDGT1      LDGT2      LDGT       HDGV      LDDV      LDDT      HDDV      MC      All Veh
 Veh. Speeds:      19.6      19.6       19.6                  19.6      19.6      19.6      19.6      19.6
```

```
    VMT Mix:       0.735     0.136     0.083               0.013     0.011     0.004     0.012     0.006

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       3.11      4.40      5.85      4.95     10.50      0.49      0.72      2.37      5.39     3.578
Exhaust  CO:      15.94     33.88     40.37     36.34     84.23      1.42      1.67     11.17     19.45    21.052
Exhaust NOX:       1.15      1.94      2.30      2.08      5.54      1.34      1.56     18.00      0.83     1.614
-------------------------------------------------------------------------------------------------------------

User supplied  mileage accrual distributions, veh registration distributions.

Cal. Year: 2000         I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                  Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI        ASTM Class: C       Minimum Temp:  60. (F)        Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5   In-use Start Yr: 2020

  Veh. Type:        LDGV      LDGT1     LDGT2      LDGT      HDGV      LDDV      LDDT      HDDV       MC    All Veh
Veh. Speeds:        19.6      19.6      19.6                 19.6      19.6      19.6      19.6      19.6
    VMT Mix:       0.714     0.122     0.082               0.013     0.033     0.018     0.012     0.006

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       2.64      3.08      3.44      3.22      6.92      0.41      0.63      2.04      5.32     2.716
Exhaust  CO:      12.61     23.50     26.82     24.83     40.71      1.32      1.55     10.21     19.45    14.931
Exhaust NOX:       0.95      1.51      1.60      1.55      4.47      1.00      1.20      8.43      0.83     1.213
-------------------------------------------------------------------------------------------------------------
```

PB89-164271

EPA-AA-TEB-89-01

USER'S GUIDE

to

MOBILE4

(MOBILE SOURCE EMISSION FACTOR MODEL)

FEBRUARY 1989

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR AND RADIATION
OFFICE OF MOBILE SOURCES
EMISSION CONTROL TECHNOLOGY DIVISION
TEST AND EVALUATION BRANCH
2565 PLYMOUTH ROAD
ANN ARBOR, MICHIGAN 48105

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL INFORMATION SERVICE
SPRINGFIELD, VA. 22161

```
    VMT Mix:       0.735    0.136    0.083             0.013    0.011    0.004    0.012    0.006

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       3.11     4.40     5.85     4.95    10.50     0.49     0.72     2.37     5.39    3.578
Exhaust  CO:      15.94    33.88    40.37    36.34    84.23     1.42     1.67    11.17    19.45   21.052
Exhaust NOX:       1.15     1.94     2.30     2.08     5.54     1.34     1.56    18.00     0.83    1.614
------------------------------------------------------------------------------------------------------

User supplied  mileage accrual distributions, veh registration distributions.

Cal. Year: 2000        I/M Program: No       Ambient Temp: 78.1 / 78.1 / 78.1 (F) Region: Low
                 Anti-tam. Program: No     Operating Mode: 20.6 / 27.3 / 20.6   Altitude:  500. Ft.

Ann Arbor     MI        ASTM Class: C         Minimum Temp:  60. (F)         Maximum Temp:  84. (F)
   Base RVP: 11.5       In-use RVP: 11.5   In-use Start Yr: 2020

  Veh. Type:        LDGV     LDGT1    LDGT2     LDGT     HDGV     LDDV     LDDT     HDDV      MC    All Veh
Veh. Speeds:        19.6     19.6     19.6               19.6     19.6     19.6     19.6     19.6
    VMT Mix:       0.714    0.122    0.082              0.013    0.033    0.018    0.012    0.006

Composite Emission Factors (Gm/Mile)
Non-Meth HC:       2.64     3.08     3.44     3.22     6.92     0.41     0.63     2.04     5.32    2.716
Exhaust  CO:      12.61    23.50    26.82    24.83    40.71     1.32     1.55    10.21    19.45   14.931
Exhaust NOX:       0.95     1.51     1.60     1.55     4.47     1.00     1.20     8.43     0.83    1.213
------------------------------------------------------------------------------------------------------
```